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PHILOSOPHICAL TRANSACTIONS.

GIVING SOME

ACCOUNT

OF THE

Preſent Undertakings, *Studies*, and *Labours*,

OF THE

INGENIOUS,

IN MANY

Conſiderable Parts of the WORLD.

VOL. XXXIX. For the Years 1735, 1736.

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PRINTERS to the ROYAL SOCIETY.
M.DCC.XXXVIII.

TO

HERMAN BOERHAAVE,

A. L. M. PHILOS. AND M. D.

PROFESSOR of PHYSICK
IN THE
UNIVERSITY *of LEYDEN*,

PRESIDENT OF THE COLLEGE OF CHIRURGIONS
IN THAT CITY.

FELLOW *of the* ROYAL SOCIETY
of LONDON,

AND

MEMBER *of the* ROYAL ACADEMY *of*
SCIENCES *at PARIS*, &c.

Honoured SIR,

AN Addreſs to You in *Engliſh* needs no Apology, ſince it is well known to all, who have the Happineſs of an intimate Acquaintance with You, that not only the

Engliſh, but likewiſe all the other *European* Languages, in which any Pieces valuable for the Improvement of Learning have been publiſhed, are alike familiar to You.

The Honour You have done me in communicating to the ROYAL SOCIETY through my Hands thoſe curious and elaborate *Experiments* you made upon *Quickſilver*, cannot be acknowledged by me in a fitter Manner, than by dedicating to You this Thirty-ninth Volume of *Philoſophical Tranſactions*: which likewiſe gives me an Opportunity of publickly thanking You for the many Marks of Friendſhip and Eſteem I have received at your Hands, for the Civilities You have always ſhewn my Friends, and the Honour You have done me in continuing an Epiſtolatory Correſpondence ever ſince I left *Leyden*.

I reckon it a great Happineſs, the having been near five Years one of your Pupils, during which Time You were ſo kind as to direct and adviſe me in all my Studies; and I gratefully own, that it was You who firſt led me into thoſe Philoſophical Reſearches, which have ſince procured me the particular Favour of our Worthy *Preſident*, and the great Honour conferred upon me by *Him*, the *Council* and *Fellows* of the ROYAL SOCIETY, in chuſing me One of their *Secretaries*.

Were theſe Volumes publiſhed in the Name of the ROYAL SOCIETY, they would not require the Patronage of any Particular Perſon; a Sanction from that Illuſtrious Body, which hath all along ſo juſtly been in the higheſt Eſteem among the Learned, would be a ſufficient Protection for the Publiſher: But, as they contain only ſome of the Papers which have been read at their Aſſemblies, the publication of which is left to the Diſcretion of the Secretaries, the Editor becomes anſwerable for what he communicates to the Publick; therefore, as to the Share I have had in collecting and publiſhing theſe Memoirs, I beg Leave to apply to You for Protection, who are a thorough Judge of their Uſefulneſs, and who have, by your univerſal Knowledge, deſervedly obtain'd a Place in the firſt Rank of Learned Men.

I hope You will accept this as a Token of the moſt ſincere Reſpect and higheſt Regard, which I ſhall ever retain for You, being,

SIR,

Your moſt obliged,

and moſt devoted,

humble Servant,

LONDON,
Aug. 1. 1738.

CROMWELL MORTIMER, *M. D.*
Secretary to the ROYAL SOCIETY, and
Fellow of the ROYAL COLLEGE of
PHYSICIANS, *LONDON.*

Numb. 436.

Beginning Vol. XXXIX.

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I. *A Catalogue of the* FIFTY PLANTS, *from* Chelſea-Garden, *preſented to the* Royal Society *by the Company of* Apothecaries, *for the Year* 1733. *purſuant to the Direction of Sir* Hans Sloane, *Bart. Med. Reg. Præſ. Col. Reg. Med. & Soc. Reg. by* Iſaac Rand, *Apothecary. F. R. S. Hort. Chel. Præſ. ac Prælec. Botan.*

551. ABROTANUM mas, anguſtifolium, majus. C. B. 136.

552. Abrotanum mas, anguſtifolium, ſegmentis foliorum tenuiſſimis.

553. Anonis flore minimo; Siliquis craſſis, in foliorum alis ſeſſilibus.

Ononis lutea, ſylveſtris minima. Column. Ecph. 304

554. Buphthalmum Creticum; Cotulæ facie, flore albo. Breyn. Cent. 1. f. 75.

555. Cicer ſativum. C. B. 347.

556. Convolvulus Americanus, minor; Polygoni ſubhirſuto folio; flore parvo, cæruleo, patente.

Huic accedit *Viſnu-Clandi*. Hort. Malab. 11. p. 131. Tab. 64

557. Convolvulus major, rectus, Creticus, argenteus. Mor. Hiſt. 2. p. 11.

558. Convolvulus ramoſus, incanus; foliis Piloſellæ. C. B. 294.

559. Elæagnus Ortentalis, anguſtifolius; fructu parvo, Olivæ formi, ſubdulci. T. Cor. 53.

Ziziphus alba. Cluſ. Hiſt. 29.

560. Fraxinus florifera, botryoides. Moriſ. H. Reg. Bleſ. 265.

561. Granadilla Hiſpanis; Flos Paſſionis Italis. Col. in Recch. 889.

562. Granadilla; folio tricuſpidi, latiori; flore minimo. An

Granadilla, folio tricuſpidi; flore parvo, flaveſcente. T. Inſt. 240?

563. Hyſſopus; rubro flore. C. B. 217.

564. Jaſminum Azoricum, trifolium; flore albo, odoratiſſimo. H. Amſt. 1. p. 159.

565. Lachryma Job. Cluſ. Hiſt. CCXVI.

566. Lotus hæmorrhoidalis, humilior & candidior. T. Inſt. 403.

567. Lychnidea Caroliniana; floribus quaſi umbellatim diſpoſitis; foliis lucidis, craſſis, acutis. Martyn Hiſt. p. 10.

568. Marrubium album, vulgare. C. B. Pin. 230.

569. Marrubium album, anguſtifolium, perigrinum, Ibid.

570. Marrubium album, latifolium, peregrinum. Ibid.

571. Mentha hortenſis, prior. Fuchſ. Hiſt. 288.

572. Mentha prima. Dod. Pempt. 95.

573. Mentha hortenſis, verticillata; Ocimi odore. C. B. Pin. 227.

Mentha quarta. Dod. Pempt. 95.

574. Mentha ſylveſtris; rotundiore folio, C. B. Pin. 227.

575. Mentha ſylveſtris; rotundiore folio; purpureo flore. Bot. Monſp.

576. Mentha ſylveſtris, ſpicata, latifolia, hirſuta.

577. Mentha Piperitis. Off. Lond.

Mentha; Spicis brevioribus & habitioribus; foliis Menthæ fuſcæ; ſapore fervido Piperis. Raij. Syn. Ed. 3. p. 234.

578.

578. Molucca lævis. Dod. Pempt. 92.

579. Momordica vulgaris. T. Inſt. p. 103.

580. Momordica Zeylanica, pampinea, fronde, fructu longiori. Ibid.

Pandi Pavel. Hort. Mal. 8. 17.

581. Omphalodes pumila, verna; Symphyti folio. T. Inſt. 140.

582. Onagra Bonarienſis, villoſa; flore mutabili. Hort. Elt. 297. Tab. 219.

583. Paronychia Hiſpanica. Cluſ. Hiſt. CLXXXII.

584. Phytolacca Americana; majori fructu. T. Inſt. 299.

Solanum magnum Virginianum rubrum. Park. Theat. 347.

585. Phytolacca Mexicana; baccis Seſſilibus. Hor. Elt. 318.

586. Phytolacca Americana, minor; bacca monopyrena.

Solanoides Pariſienſium.

587. Ptarmica Orientalis; Santolinæ folio; flore minori. T. Cor. 37.

588. Rapuntium Trachelii folio; flore purpuraſcente. Plum. Cat. p. 5.

589. Ricinoides Americana; Alni folio, oblongo. A Dno. Houſton.

An *Ricinoides Americana, Caſtaneæ ſolio.* Plum. Cat. p. 20.

590. Scabioſa ſtellata, Orientalis; floſculis marginalibus fimbriatis

591. Spermacoce; verticillis tenuoribus. Hort. Elt. Tab. 277. f. 259.

592. Symphoricarpos; foliis alatis. Hort. Elt. 371. Tab. 278.

593. Tanacetum Africanum, arboreſcens; foliis Lavendulæ multifido folio. Hort. Amſt. 2. p. 201.

594. Telephioides Græca, humifuſa; flore albo. T. Cor. 50.

595. Tithymalus Americanus, ramoſiſſimus; Ocimi minoris folio. A D. Houſton.

596. Turnera fruteſcens; Ulmi folio. Plum. Nov. Gen p, 15.

597. Turnera; Lycopi folio; flore ampliore.

Ciſtus; *Urticæ folio*; *flore luteo*; *vaſculis trigonis.* Sloan Hiſt. Vol. I. Tab. 127, fig. 4 & 5.

598. Virga aurea, major; foliis glutinoſis & graveolentibus. T. Inſt. 484.

599. Virga aurea; Ulmi folio; Virginiana.

Virga aurea Americana, aſpera; *foliis brevioribus ſerratis.* Hort. Elt. 411.

600. Vitex foliis anguſtioribus; Cannabis modo diſpoſitis. C. B. Pin. 475.

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ECLIPSES *of the firſt Satellite of* JUPITER.

D.	H.	M.	S.
JANUARY.			
Immerſions.			
Jupiter and the Sun in Conjunction.			
27	10	20	4
29	4	48	33
30	23	17	3
FEBRUARY.			
Immerſions.			
1	17	45	38
3	12	14	15
5	6	42	51
7	1	11	32
8	19	40	14
10	14	8	58
12	8	37	44
14	3	6	30
15	21	35	22
17	16	4	12
19	10	33	3
21	5	1	56
22	23	30	50
24	17	59	46*
26	12	28	44
28	6	57	41
MARCH.			
Immerſions.			
1	1	26	40
2	19	55	40
4	14	24	39
6	8	53	40
8	3	22	42
9	21	51	43
11	16	20	44*
13	10	49	49
15	5	18	51
16	23	47	52
18	18	16	52
20	12	45	54
22	7	14	54
24	1	43	56
25	20	12	53
27	14	41	50
29	9	10	50
31	3	39	45
APRIL.			
Immerſions.			
1	22	8	41
3	16	37	36
5	11	6	30*
7	5	35	22
9	0	4	14
10	18	33	01
12	13	1	53
14	7	30	39
16	1	59	24
17	20	28	7
19	14	56	47*
21	9	25	26

ECLIPSES *of the firſt Satellite of* JUPITER.

D.	H.	M.	S.
23	3	54	4
24	22	22	41
26	16	51	16
28	11	19	48
30	5	48	21

MAY.

Immerſions.

D.	H.	M.	S.
2	0	16	50
3	18	45	20
5	13	13	45*
7	7	42	10
9	2	10	33
10	20	38	55
12	15	7	15*
14	9	35	34
16	4	3	50
17	22	32	5
19	17	0	21
21	11	28	34
23	5	56	46
25	0	24	56
26	18	53	8
28	13	21	21*
30	7	49	25.

JUNE.

Immerſions.

D.	H.	M.	S.
1	2	17	34
2	20	45	43
4	15	13	50*
6	9	41	59
8	4	10	5
9	22	38	13
11	17	06	22
13	11	34	30*
15	6	2	39
17	0	30	50
18	18	59	0
20	13	27	11*
22	7	55	23
24	2	23	37
25	20	51	51
27	15	20	8*
29	9	48	27

JULY.

Immerſions.

D.	H.	M.	S.
1	4	16	45
2	22	45	9
4	17	13	32
6	11	41	57*
8	6	10	28
10	0	38	53
11	19	7	24
13	13	35	55*
15	8	4	32*
17	2	33	14
18	21	1	57
20	15	30	40*
22	9	59	25*
24	4	28	14

Emerſions.

D.	H.	M.	S.
24	6	45	13
26	1	14	4
27	19	42	56
29	14	11	48*
31	8	40	45*

AUGUST.

Emerſions.

D.	H.	M.	S.
2	3	9	47
3	21	38	50
5	16	7	53*
7	10	36	57
9	5	6	1
10	23	35	11
12	18	4	22
14	12	33	33*
16	7	2	48
18	1	32	2
19	20	1	19
21	14	30	36*
23	8	59	55
25	3	29	14
26	21	58	36
28	16	27	57*
30	10	57	21*

SEP-

ECLIPSES *of the firſt Satellite of* JUPITER.

SEPTEMBER.

Emerſions.

D.	H.	M.	S.
1	5	26	46
2	23	56	10
4	18	25	34
6	12	55	0*
8	7	24	27
10	1	53	53
11	20	23	18
13	14	52	44
15	9	22	9*
17	3	51	33
18	22	20	55
20	16	50	19
22	11	19	40*
24	5	49	1
26	0	18	20
27	18	47	39
29	13	16	55*

OCTOBER.

Emerſions.

D.	H.	M.	S.
1	7	46	10*
3	2	15	24
4	20	44	43
6	15	13	48
8	9	42	58*
10	4	12	5
11	22	41	10
13	17	10	15
15	11	39	15*
17	6	8	12
19	0	37	8
20	19	6	0
22	13	34	52
24	8	3	40*
26	2	32	28
27	21	1	8
29	15	29	47
31	9	58	26*

NOVEMBER.

Emerſions.

D.	H.	M.	S.
2	4	27	5
3	22	55	38
5	17	24	8
7	11	52	36
9	6	21	3
11	0	49	26
12	19	17	48
14	13	46	6
16	8	14	21*
18	2	42	35
19	21	10	46
21	15	38	55
23	10	7	3
25	4	35	7
26	23	3	11
28	17	31	13
30	11	59	16

DECEMBER.

Emerſions.

D.	H.	M.	S.
2	6	27	16*
4	0	55	12
5	19	23	8
7	13	51	3
9	8	18	57*
11	2	46	51
12	21	14	46
14	15	42	41
16	10	10	36
18	4	38	32*
19	23	6	27
21	17	34	25
23	12	2	23
25	6	30	22*
27	0	58	23
28	19	26	24
30	13	54	29

ECLIPSES *of the ſecond Satellite of* JUPITER.

D.	H.	M.	S.
JANUARY.			
Immerſions.			
Jupiter and the Sun in Conjunction.			
25	2	49	26
28	16	7	8
FEBRUARY.			
Immerſions.			
1	5	24	59
4	18	42	55*
8	8	1	2
11	21	19	16
15	10	37	39
18	23	56	5
22	13	14	35
26	2	33	14
29	15	51	55
MARCH.			
Immerſions.			
4	5	10	40
7	18	39	29
11	7	48	18
14	21	7	9

D.	H.	M.	S.
18	10	25	57
21	23	44	46
25	13	3	30
29	2	22	12
APRIL.			
Immerſions.			
1	15	40	52*
5	4	59	28
8	18	17	59
12	7	36	25
15	20	54	45
19	10	12	54
22	23	30	58
26	12	48	59
30	2	6	49
MAY.			
Immerſions.			
3	15	24	37*
7	4	42	14
10	17	59	47
14	7	17	12
17	20	34	32
21	9	51	47
24	23	8	58
28	12	26	4*

D.	H.	M.	S.
JUNE.			
Immerſions.			
1	1	43	9
4	15	0	15*
8	4	17	18
11	17	34	18
15	6	52	25
18	20	8	35
22	9	25	45*
25	22	43	1
29	12	0	25*
JULY.			
Immerſions.			
3	1	17	56
6	14	35	33*
10	3	53	20
13	17	11	10
17	6	29	19
20	19	47	35
Emerſions.			
24	11	59	54*
28	1	18	29
31	14	37	9*

AUGUST.

ECLIPSES *of the ſecond Satellite of* JUPITER.

D.	H.	M.	S.
AUGUST.			
Emerſions.			
4	3	56	0
7	17	14	59
11	6	34	5
14	19	53	13
18	9	12	32*
21	22	31	54
25	11	51	23*
29	1	10	54
SEPTEMBER.			
Emerſions.			
1	14	30	31
5	3	50	11
8	17	9	55
12	6	29	36
15	19	49	15
19	9	8	51*
22	22	28	25
26	11	47	54*
30	1	7	18
OCTOBER.			
Emerſions.			
3	14	26	42
7	3	45	54
10	17	5	1
14	6	24	0*
17	19	42	48
21	9	1	24*
24	22	19	55
28	11	38	10
NOVEMBER.			
Emerſions.			
1	0	56	19
4	14	14	17
8	3	32	1
11	16	49	37
15	6	7	1*
18	19	24	7
22	8	41	22*
25	21	58	22
29	11	15	16
DECEMBER.			
Emerſions.			
3	0	32	6
6	13	48	47
10	3	5	27
13	16	22	6
17	5	38	47*
20	18	55	30
24	8	12	15
27	21	29	6
31	10	45	59

ECLIPSES *of the third Satellite of* JUPITER.

D.	H.	M.	S.
JANUARY.			
Immerſions.			
Jupiter and the Sun in Conjunction.			
29	10	3	18
FEBRUARY.			
Immerſions.			
5	14	3	8
12	18	3	34*
19	22	4	26
27	2	5	49
Emerſions.			
27	5	39	38
MARCH.			
Immerſions.			
5	6	7	15
12	10	8	56
19	14	10	48
26	18	12	19
Emerſions.			
5	9	40	57
12	13	42	52

D.	H.	M.	S.
19	17	45	8
26	21	46	43
APRIL.			
Immerſions.			
2	22	13	45
10	2	14	52
17	6	15	35
24	10	15	48
Emerſions.			
3	1	48	23
10	5	49	44
17	9	50	39
24	13	51	2*
MAY.			
Immerſions.			
1	14	15	46*
8	18	15	16
15	22	14	19
23	2	13	1
30	6	11	26
Emerſions.			
1	17	51	8
8	21	50	44

M.	H.	D.	S.
16	1	49	53
23	5	48	41
30	9	47	12
JUNE.			
Immerſions.			
6	10	9	44
13	14	8	1*
20	18	6	34
27	22	5	14
Emerſions.			
6	13	45	36*
13	17	43	57
JULY.			
Immerſions.			
5	2	4	35
12	6	4	27
19	10	5	4*
Emerſions.			
Jupiter and the Sun in Oppoſition.			
26	17	42	1

AUGUST.

ECLIPSES *of the third Satellite of* JUPITER.

AUGUST.

Immerſions.

Jupiter and the Sun in Conjunction.

Emerſions.

D.	H.	M.	S.
2	21	43	42
10	1	45	56
17	5	48	40
24	9	51	44*
31	13	55	7*

SEPTEMBER.

Immerſions.

D.	H.	M.	S.
7	14	23	34
14	18	27	26
21	22	31	9
29	2	34	34

Emerſions.

D.	H.	M.	S.
7	17	58	48
14	22	2	32
22	2	6	7
29	6	9	24*

OCTOBER.

Immerſions.

D.	H.	M.	S.
6	6	37	47*
13	10	40	28*
20	14	42	27
27	18	43	46

Emerſions.

D.	H.	M.	S.
6	10	12	15*
13	14	14	42
20	18	16	27
27	22	17	32

NOVEMBER.

Immerſions.

D.	H.	M.	S.
3	22	44	32
11	2	44	32
18	6	43	53*
25	10	42	39

Emerſions.

D.	H.	M.	S.
4	2	18	4
11	6	17	48*
18	10	16	51
25	14	15	17

DECEMBER.

Immerſions.

D.	H.	M.	S.
2	14	41	0
9	18	39	0
16	22	36	58

Emerſions.

D.	H.	M.	S.
2	18	13	16
9	22	10	54
17	2	8	28
24	6	6	11*
31	10	4	10

ECLIPSES *of the fourth Satellite of* JUPITER.

D.	H.	M.	S.		D.	H.	M.	S.
				JANUARY.				
Immerſions.					Emerſions.			
28	9	32	6		28	14	17	8
				FEBRUARY.				
14	3	44	49		14	8	22	11
				MARCH.				
1	21	57	2		2	2	34	58
18	16	9	29*		18	20	49	29
				APRIL.				
4	10	21	9		4	15	2	53*
21	4	31	22		21	9	14	32
				MAY.				
7	22	40	8		8	3	24	44
24	16	47	16		24	21	32	30
				JUNE.				
10	10	52	23*		10	15	38	1*
27	4	58	33		27	9	44	29*
				JULY.				
13	23	7	44		♃	☉	☌	
♃	☉	☌			30	22	6	51
				AUGUST.				
16	11	36	52*		16	16	21	38
				SEPTEMBER.				
2	5	54	56		2	10	39	2*
19	0	15	10		19	4	57	44
				OCTOBER.				
5	18	35	0		5	23	16	0
22	12	51	24		22	17	30	28
				NOVEMBER.				
8	7	4	46*		8	11	41	38
25	1	15	2		25	5	49	18*
				DECEMBER.				
11	19	22	37		11	23	54	5
28	13	30	42		28	17	58	58

III. *The apparent Times of ſuch of the* Immerſions *and* Emerſions *of* Jupiter's *Satellites, as are viſible at* London, *in the Year* 1736. *together with their Configurations at thoſe Times repreſented in a Plate (vide* TAB.*) by the ſame.*

—	D.	H.	M.			
	JANUARY.					
	♃ ☉ ☌					
	FEBRUARY.					
1	5	6	43	M	I.	2
2	13	6	4	M	I.	3
3	25	6	0	M	I.	1
	MARCH.					
4	12	4	21	M	I.	1
5	19	4	9	M	I.	4
	APRIL					
6	2	3	41	M	I.	2
7	4	4	38	M	I.	1
8	5	3	3	M	E.	4
9	20	2	57	M	I.	1
10	25	1	51	M	E.	3
	MAY.					
11	2	2	16	M	I.	3
12	4	3	25	M	I.	2
13	6	1	14	M	I.	1
14	13	3	7	M	I.	1
15	29	0	26	M	I.	2
16	00	1	21	M	I.	1
	JUNE.					
17	5	3	00	M	I.	2
18	00	3	14	M	I.	1
	JUNE.					
19	7	1	46	M	E.	3
20	10	10	52	A	I.	4
21	11	3	38	M	E.	4
22	13	11	34	A	I.	1
23	14	2	8	M	I.	3
24	21	1	27	M	I.	1
25	22	9	26	A	I.	2
26	27	9	44	A	E.	4
27	28	3	20	M	I.	1
28	29	12	00		I.	2
	JULY.					
29	6	11	42	A	I.	1
30	7	2	36	M	I.	2
31	14	1	36	M	I.	1
32	15	8	4	A	I.	1
33	19	10	5	A	I.	3
34	21	3	31	M	I.	1
35	22	9	59	A	I.	1
36	24	12	00		E.	2
37	30	2	12	M	E.	1
38	31	8	41	A	E.	1
	AUGUST.					
39	1	2	37	M	E.	2
40	6	4	8	M	E.	1
41	15	0	34	M	E.	1
42	16	11	37	A	I.	4

AUGUST

	D.	H.	M.			
	AUGUST.					
43	18	9	13	A	E.	2
44	22	2	31	M	E.	1
45	24	9	52	A	E.	3
46	25	11	51	A	E.	2
47	29	4	28	M	E.	1
48	30	10	57	A	E.	1
	SEPTEMBER.					
49	1	1	55	M	E.	3
50	2	10	39	A	E.	4
51	7	0	55	M	E.	1
52	15	9	22	A	F.	1
53	19	9	9	A	E.	2
54	22	11	20	A	E.	1
55	26	11	48	A	E.	2
56	29	6	9	A	E.	3
57	30	1	17	M	E.	1
	OCTOBER.					
58	1	7	46	A	E.	1
59	6	6	38	A	I.	3
60		10	12	A	E.	3
61	8	9	43	A	E.	1
62	13	10	40	A	I.	3
	OCTOBER.					
63	14	6	24	A	E.	2
64	15	11	39	A	E.	1
65	21	9	1	A	E.	2
66	24	8	4	A	E.	1
67	31	9	58	A	E.	1
	NOVEMBER.					
68	8	7	5	A	I.	4
69	11	6	18	A	E.	3
70	16	6	7	A	E.	2
71	16	8	14	A	E.	1
72	18	6	44	A	I.	3
73	22	8	41	A	E.	2
74	25	5	49	A	E.	4
	DECEMBER.					
75	2	6	27	A	E.	1
76	9	8	19	A	E.	1
77	17	5	39	A	E.	2
78	18	4	39	A	E.	1
79	24	6	6	A	E.	3
80	25	6	30	A	E.	1

In all 80.

The 2*d* and 5*th* Columns, ſhew the Times when the Eclipſes will happen; the 3*d* and 6*th*, ſhew the Kind. Thus, on the 5*th* of *February*, at 6 h. 43 m. in the Morning there will happen an Immerſion of the ſecond Satellite; and the Number 1, which is placed againſt the 5*th* of *February* in the 1*ſt* Column, refers to the Number 1 in the 1*ſt* Column of the *Plate* of *Configurations*, againſt which is placed the *Correſpondent Configuration*, or the Form in which the Satellites will appear at that Time.

IV. *An*

IV. *An Account of ſome Obſervations of the* Eclipſes *of the* Firſt Satellite *of* Jupiter, *compared with the Tables, by the ſame.*

BY comparing 244 Eclipſes of the *firſt Satellite* of *Jupiter*, obſerved between the Years 1677 and 1731, with the *Flamſteedian* Tables, corrected by my ſelf, from which Tables the preceding Catalogue of Eclipſes is deduced, I find there are 74, which make up near one Third of the whole Number, that do not differ one Minute from the Tables; 127, which are above one Half, that do not differ two Minutes; 181, which are two Thirds of the whole Number, that do not differ three Minutes; and 214, which are ſeven Eighths, that do not differ four Minutes, the reſt not differing above five Minutes and one half, which is a Degree of Exactneſs ſufficient in my Opinion to recommend the Uſe of theſe Eclipſes to our Navigators, to determine the Difference of Longitude, eſpecially ſince they may be ſeen with a Teleſcope of three Feet, as is aſſerted in *Page* 169 of the *Connoiſſance Des Temps* for the preſent Year; and if this be true, I will venture to affirm, That an Immerſion or Emerſion, obſerved with this Teleſcope, will not differ one half Minute from the Time obſerved with the largeſt Teleſcope: However that be, it is but comparing an Obſervation of the ſame Eclipſe, made with theſe two different Teleſcopes together, and the Difference of the Times will be diſcovered, which will ſerve for ever afterwards as a Rule to adjuſt the Obſervations.

The only View that I have in communicating this Paper, and in computing the Eclipſes for Time to come, is to encourage thoſe Perſons, who will find their Advantage in it, to make Uſe of this Help for obtaining the Longitude at Sea, till better Methods are offered.

V Experiments *and* Obſervations *upon the* Light *that is produced by communicating* Electrical Attraction *to animal or inanimate Bodies, together with ſome of its moſt ſurpriſing Effects; communicated in a Letter from Mr.* Stephen Gray, *F. R. S. to* Cromwell Mortimer, *M. D. R. S. Secr.*

SIR, *Charter-Houſe, Jan.* 28th, 1734-5.

IT is now ſome Months ago that I promiſed to give the *Society* an Account of what Experiments I had then made; but ſoon after there occurr'd to my Thoughts ſeveral others, which I was willing to try the Succeſs of; which Experiments requiring an Addition to the *Apparatus*, that I might make them more compleat, I hope will be a ſufficient Apology for this Delay.

I ſee you have publiſhed Mr. *Dufay*'s Letter to the Duke of *Richmond*, in the *Philoſophical Tranſactions*,

actions, N° 431. 'tis no ſmall Satisfaction to me, that my Electrical Diſcoveries have not only been confirmed by ſo judicious a Philoſopher as Mr. *Dufay*; but that he has made ſeveral new ones of his own, more eſpecially that important luciferous one, which put me upon making the Experiments I am now going to relate.

I ſhall firſt give ſome Account of the Experiments made the laſt *Spring*, ſoon after I received the Tranſlation of Mr. *Dufay*'s Letter; then of thoſe we made at my honoured Friend's, *Granvill Wheler*, Eſq; *F.R.S.* in the Months of *July* and *Auguſt*; and laſtly proceed to thoſe I have made ſince my Return to *London*, which was in *September* laſt.

As I had not any ſilk Lines by me ſtrong enough to bear the Boy, I cauſed him to ſtand on ſome of the Electric Bodies; and, as I concluded, found the Effect the ſame as mentioned by Mr. *Dufay*. I ſhall not need to mention the Particulars of the Experiment, but proceed to thoſe that were ſuggeſted to me upon Mr. *Dufay*'s ſaying, that theſe Snappings or Sparks are not excited, if a Piece of Wood, or any other Subſtance than a living Body, be paſſed over the Perſon ſuſpended on the Lines, unleſs it be a Piece of Metal: From thence I concluded, that if I ſuſpended the Metal upon ſilk Lines, or laid it upon any of the Electric Bodies, the Effect muſt be the ſame, when the Metal had been made Electrical by the Tube, and the Hand of any one was held near it, and found it ſucceeded accordingly. I began firſt with ſome common Utenſils that were at Hand, ſuch as the Iron Poker, Tongs, and Fire Shovel; any of theſe being ſuſpended upon Lines of the largeſt ſewing Silk then the excited Tube, being applied firſt to the Knob of the Poker, and after it the Hand, there was the Snap and Pricking felt, as I expected; and the Effect was the ſame, when the Tube was firſt applied to the other End of the Poker. I had by me a three pronged Iron Inſtrument, which was made many Years ago; its Uſe was deſigned for propping up the Obſervatory Table, when I obſerved the Spots in the Sun; the Prongs were about half an Inch Diameter, two of them about 22 Inches, and the third about 8 Inches long; they were tapering towards the Ends, and pointed: this being laid either upon Cylinders of Glaſs, Cakes of Roſin and Bees Wax, or on a Cake of Sulphur, the Tube being applied to the End of any of the Legs, the Hand or Cheek being applied near the other, both the other Legs had the ſame Effect as that to which the Tube had been applied; but by holding my Cheek near any of the Points of the Legs, the pricking or burning Pain was much more ſenſibly felt, and was ſometimes felt for ſeveral Minutes after. I was not ſo inquiſitive at that Time about making the Experiment in the Dark, that I might ſee the Light proceeding from the Iron, not thinking the Electricity communicated to the Metals would have produced ſo ſurpriſing Phænomena, as by the following Account of the Experiments will be deſcribed.

1. I come now to give ſome Account of the Experiments we made at Mr. *Wheler's*, beginning firſt with the Succeſs we had in repeating Mr. *Dufay's* Experiment. Mr. *Wheler*, ſoon after my coming to him, procured ſilk Lines ſtrong enough to bear the Weight of his Footboy, a good ſtout Lad; then having ſuſpended him upon the Lines, the Tube being

applied to his Feet or Hands, and the Finger of any one that ſtood by held near his Hands or Face, he found himſelf pricked or burnt, as it were by a Spark of Fire, as Mr. *Dufay* had related, and the ſnapping Noiſe was heard at the ſame Time; but it did not ſucceed with us, when we applied our Hands to any part of his Body through his Cloaths, except upon his Legs, upon which he felt the Pain through his Stockings, although they were very thick ones.

2. Being deſirous to make the Experiment upon another Species of Animals, we took a large white Cock, and ſuſpended him upon the Lines firſt alive, and the Effect was the ſame as on the Boy, whether we applied our Fingers to any Part of his Body, or our Cheek to his Beak, Comb or Claws; then the Cock was killed, and put on the Lines again, and we found very little, if any, Difference, from the Effect it had on us when the Cock was living: We then cauſed the Cock to be ſtripped of his Feathers, and the Difference from what has been ſaid before was not very great.

3. We took a large Sirloin of Beef, that came from an Ox that had been killed two Days before, and ſuſpended it on the ſilk Lines; then the Fingers held near any Part of it, there was a Snapping, and the Fingers were puſhed or pricked; but the Snapping was thought not to be quite ſo loud as when the Experiment was made on the Cock.

4. We cauſed to be made an Iron Rod, 4 Foot long, and about half an Inch Diameter, pointed at each End, but not ſharp, being left about the Bigneſs of a Pin's Head, this being ſuſpended on the Lines; then the Tube being rubb'd, and held near one End of the

Rod, and then the Finger or Cheek being put near either End of the Rod, the Effect was the ſame as when an Animal had been ſuſpended on the Lines, with reſpect to the pricking Pain we felt.

5. At Night we made the luminous Part of the Experiment, ſuſpending the Iron Rod on the ſilk Lines; then applying one End of the Tube to one End of the Rod, not only that End had a Light upon it, but there proceeded a Light at the ſame Time from the other, extending in Form of a Cone, whoſe Vertex was at the End of the Rod, and we could plainly ſee that it conſiſted of Threads, or Rays of Light, diverging from the Point of the Rod, and the exterior Rays being incurvated. This Light is attended with a ſmall hiſſing Noiſe; every Stroke we give the Tube, cauſes the Light to appear: the Hiſſing ſeems to begin at that End of the Rod next the Tube, and as it comes, increaſes in its Loudneſs, but it is ſo ſmall as not to be heard without good Attention, and by thoſe only that ſtand at that End of the Rod from whence the ſaid Light proceeds.

Mr. *Godfrey* being deſirous to ſee theſe Experiments, I repeated them, by laying a Rod of Iron upon a Cake of Shell-Lake, which was laid upon a Glaſs Veſſel; but the Effects being much the ſame with what has been above-mentioned, I ſhall not need to mention any other Particulars.

1. I ſhall now proceed to give ſome Account of the Experiments I have made ſince my Return to *London*, which was in *September* laſt. I cauſed three Iron Rods to be made, one of four Feet long, two, each three Feet in Length; one of theſe was made tapering toward the Ends, and pointed as that of four Feet

was; the other pointed at one End, and the other End not pointed, the Diameter of the Rods about half an Inch; they were firſt forged, then filed and burniſhed. With theſe I made the following Experiments: When any of them were laid either upon the Brims of hollow Cylinders of Glaſs well warmed, or upon Cakes of Roſin and Bees Wax, or upon thoſe of Sulphur, the Phænomenon was the ſame as when they had been ſuſpended on Silk Lines: But now I diſcover'd another very ſurpriſing one, *viz.* that after the Tube had been applied, and the Light ſeen at both Ends, upon my going to the other End of the Rod, when there was no Light to be ſeen, upon holding my Hand at ſome diſtance from it, then moving my Hand towards it with a pretty ſwift Motion, there iſſued from that Point of the Rod a Cone of Light, as when the Tube had been applied to the other End; and upon repeating this Motion of my Hand, the ſame Phænomenon appear'd for five or ſix times ſucceſſively, only the Rays were each time ſhorter than the other; theſe Lights are alſo attended with a hiſſing Noiſe: That Light which appears upon that End next the Tube, when it is held obliquely to the Axis of the Rod, has its Rays tending towards it: All the Time I am rubbing the Tube, theſe Flaſhes of Light appear upon every Motion of my Hand up or down the Tube, but the largeſt Flaſhes are produced by the Motion of my Hand downwards.

2. When two or three Rods are laid either in a right Line, or making any Angle with each other, or either touch, or are at a ſmall Diſtance from one another, the Tube being applied to one of their Ends, the furtheſt End of the further Rod, exhibits the ſame Phænomena as one ſingle.

An

3. An Experiment with the Rod that was pointed at but one of its Ends. When the Tube is applied to the other End of the Rod, the Point gives the ſame Appearance and alike Effect with the Rods, that are pointed at each End; but the great End of the Rod, when the Hand or Cheek is applied near it, gives but one ſingle Snap; but this is much louder than the greateſt of thoſe from the Point of the Rod, and one feels a little more Pain by it.

4. I cauſed an Iron Ball to be forged, and then turned and burniſhed; 'twas two Inches Diameter, which being placed on a wooden Stand, that had a ſmall Concave at the Top, in which the Ball was placed; the Stand being ſet upon a Cylindrick Glaſs, then the excited Tube being applied near the Ball, there proceeded a Stream of Light from it, with a ſmall hiſſing Noiſe; then putting my Finger or Cheek near the Ball, there was no Snapping, nor any Pain felt, yet there appeared a very bright Light.

5. The Rod of four Feet long, being placed upon a Stand, that had a croſs Arm with a Groove in it to receive the Rod; then the Stand being placed on the Glaſs Cylinder, they were ſet at ſuch a Diſtance, as that one of the Points of the Rod might juſt touch the Ball over againſt its Centre; then going to the other End of the Rod with the prepared Tube, and applying it as uſual, when I came to the Ball, the Hand or Cheek being near it, cauſed a loud Snap, compared to thoſe made by the Points of the Rods, and the Pain of pricking or burning was more ſtrongly felt, the Light alſo was brighter and more contracted: I then placed the Rod with its Point at an

Inch diſtance from the *Ball*, and applying the Rod as before, I came to the Ball, and touching it with my Hand or Finger, there not only appeared a Light on the Ball, but there alſo proceeded a Bruſh of Light from the Point of the Rod after the ſame manner as when the Experiments had been made with the Rods only.

6. An Experiment made with the four Feet Rod, and a Braſs Plate four Feet ſquare. This was placed upon a Stand, ſo that the Plate ſtood perpendicular, the Stand being ſet on the Cylindrick Glaſs; then the Rod with its Stand and Glaſs was ſet ſo as that one Point of it was about an Inch from the Centre of the Plate; then the Tube being applied to the other End of the Rod, and after going to the Plate, on ſtriking it gently with my Finger on the back Side, a Light appeared upon the Plate, and at the ſame time the Bruſh of Light came out from the Point of the Rod; and when my Hand or Cheek was held near any of the Angles of the Plate, there was a Light came from thence with a ſmall hiſſing Noiſe, and the Pricking was felt as when the Experiments were made with the pointed Rods.

7. A Pewter Plate being laid upon the Stand, which had been ſet upon a Glaſs Cylinder, the Tube firſt, and then the Finger applied, there appeared a Light upon the Plate, and the End of the Finger was puſhed; and when the Cheek was held near the Edge of the Plate, there was a Snapping heard, but not ſo loud as when the Iron Rods were uſed. I then filled the Plate with Water, and applying the Tube and Finger as before, there was the ſame Light, puſhing of the Finger, and Snapping, as when the Experiment was made with the empty Plate. When the Experiment is made with Water by Day-light, by applying

the End of the Finger near the Surface of the Water, it appears to riſe in a little Hill, and upon the ſnapping Noiſe falls down again, putting the Water into a waving Motion near the Place where the Water had riſen.

8. I then took a wooden Diſh, and placed it upon the Stand firſt empty; then applying the Tube, and the Finheld near the Diſh, there appeared a Light, but no puſhing of the Finger nor Snapping: I then filled the Diſh with Water, and the Tube being held over the Surface of the Water, there appeared a greater Light than when the Finger had been applied to the empty Diſh, but no Snapping, till by holding the Tube after it had been well rubbed, within two or three Inches of the Finger that was held near the Surface of the Water, and then the Finger was puſhed, and a ſnapping Noiſe heard, as when the Experiment was made with the Pewter Plate.

By theſe Experiments we ſee, that an actual Flame of Fire, together with an Exploſion, and an Ebullition of cold Water, may be produced by Communicative Electricity; and altho' theſe Effects are at preſent but in *minimis*, it is probable, in Time there may be found out a Way to collect a greater Quantity of it; and conſequently to increaſe the Force of this Electrick Fire, which, by ſeveral of theſe Experiments (*Si licet magnis componere parva*) ſeems to be of the ſame Nature with that of Thunder and Lightning.

SIR,

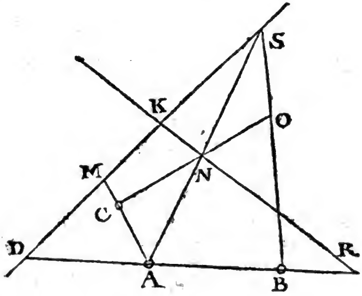
Your's and the Society's Moſt Obedient Humble Servant,

STEPHEN GRAY.

VI. *A general Method of deſcribing* Curves, *by the Interſection of* Right-Lines; *moving about Points in a given Plane. In a Letter to Dr.* Hoadly, *by the Rev. Mr.* Braikenridge.

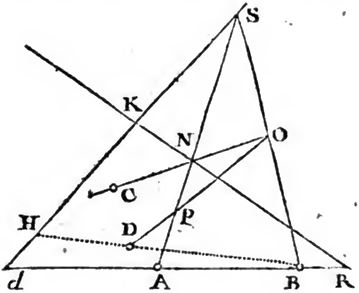
Celeberrimo Viro D. BENJ. HOADLY, M. D.
GULIELMUS BRAIKENRIDGE.
S. P. D.

CUM plurimum delectaris Matheſeos ſtudio, tantoſque progreſſus in ea ipſe feceris, haud ingratum tibi me facturum duxi, ſi nova quædam de deſcriptione Curvarum tibi mitterem, quæ a te ſi probata fuerint, procul dubio & ſana & utilia exiſtimabuntur. Habes hic ni fallor Generalem Methodum Lineas, cujuſcunque ordinis deſcribendi, ope interſectionum rectarum circa polos revolventium; quæ eſt *Neutoniana* multo ſimplicior, & quæ plurima problemata ſoluta dabit inventu difficillima; ac neſcio an ex aliis principiis inveniri queant. Hujus Methodi particularem tantum caſum explicatum dedi in Exercitatione illa Geometrica *Londini* edita anno, 1733. Illo tempore rem totam exponere nec commodum, nec aptum cenſui, quamvis Methodum bene cognitam haberem. Abhinc enim triennium eſt ex quo in Theorema Generale incideram, ſed celare multa me moverunt; et mecum ſtatui, ut biennium ſaltem peractum eſſet ab edita illa Exercitatione antequam hæc Generalis Methodus in lucem prodiret. Nihil enim dubitabam, ſi qui alii hujus Inventi potirentur, quin, particulari caſu edito, occaſionem arrepturi eſſent præſertim laceſſiti, generalem Methodum edendi, ſi talem ſibi compertam revera habuiſſent. Sed ne nimius ſim, en Methodum ipſam pluribus Propoſitionibus expreſſam, quarum demonſtrationes minutim tibi exhibere haud neceſſarium duco; ipſe enim perſpicacius hæc videbis quam ut prolixo calculo aut arduo ratiocinio indigeas. Harum prior demonſtratur in Exercitatione ſupra dicta; & in eum finem huc tranſcripta eſt, ut uno intuitu videas eam contineri ſub hac generali Methodo.



Circa tria puncta data A, B, C, in plano quovis tanquam polos moveantur tres rectæ AN S, BOS, CNO quæ ſeſe interſecent in punctis S, N, O, & ducantur duo interſectionum puncta S, & N, per rectas D K S, RNK poſitione datas; reliquum O Sectionem Conicam deſcribet. Demonſtratur in *Exerc. Geom. Prop.* I. Si per puncta A, B, C, agantur rectæ A B, A C ſibi invicem occurrentes in A & rectis R K, D K poſitione datis in R & M; Figura deſcripta tranſibit per quinque puncta, B, C, K, M, R. Et hinc patet nova methodus Sectionem Conicam deſcribendi per quinque puncta data omnibus hactenus inventis multo facilior. Vid. *Exerc. Geom. Prop.* 3.

Moveantur circa quatuor puncta A, B, C, D, in plano quovis tanquam polos totidem rectæ A N S, B O S, C N O, D P O, quarum tres A N S, B O S, C N O ſeſe interſecent in tribus punctis S, N, O, & du-

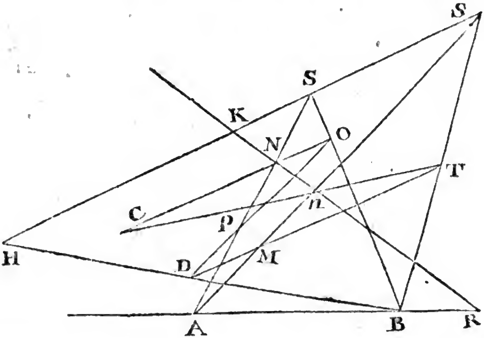


cantur duo interſectionum puncta S, N, per rectas *d* K, R K poſitione datas, & interea tranſeat per reliquum O recta D P O ducta a polo quarto D, rectamque A N S ſecet in P; atque punctum illud P deſcribet Lineam tertii ordinis. Demonſtratur ex *undecima Prop. Exerc. Geom.*

Per polos A, B, D, agantur rectæ A B R, B D H ſibi occurrentes in B, & rectis K R, K *d* poſitione datis in R, H; Figura motu puncti P deſcripta tranſibit per quinque puncta A, D, H, K, R, quorum A erit duplex. Hinc deducitur Methodus deſcribendi Lineam

tertii

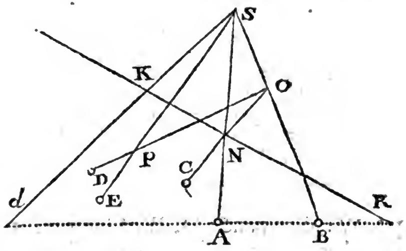
tertii ordinis per ſeptem puncta data quorum unum ſit duplex. Dentur enim A, D, H, K, P, M, R, et oportet unum A eſſe duplex. Per duo puncta, H, R, ad aliud K agantur rectæ H K, R K, & jungantur



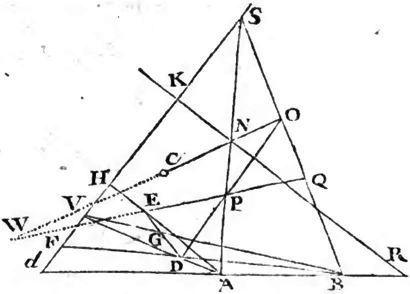
puncta A,R, & H,D, producanturque rectæ AR, HD quæ ſibi occurrant in B. Ductis per A & puncta P, M, rectis A P N S, A M *n s* quæ rectam K R ſecent in N, *n*, rectam vero H K, in S, *s*; per puncta illa S, *s*, ducantur ad B rectæ B S, B *s*, atque per D ad puncta P, M, age rectas D P O, D M T rectis B S, B *s*, occurrentes in O, T. Jungantur puncta O, N, & T, *n*, & producantur rectæ O N, T *n* quæ conveniant in C. Dein circa puncta A, B, C, D, tanquam polos rotentur rectæ A S, BO, C O, D O, quarum tres A S, BO, C O ſeſe interſecent in punctis S, N, O, & ducantur duo S, N, per rectas H K, K R & interea tranſeat ſemper recta DO per reliquum O, quæ rectam ANS ſecet in P, &

& hæc interſectio P rectarum AS, DO Lineam tertii ordinis deſcribet per ſeptem puncta data, A, D, H, K, M, P, R, tranſeuntem, dupliciter vero per datum A.

Deſcribuntur etiam Lineæ tertii ordinis generalius ſed minus commode hoc modo qui & priorem complectitur. Rotentur circa quinque puncta A, B, C, D, E, data tanquam polos totidem rectæ A N S, B O S, C N O, D P O, E P S, quarum tres A N S, B O S, C N O, ſeſe interſecent in punctis N, S, O; ducantur duo S, N, per rectas poſitione datas *d* K, K R, atque per alterutrum S, e duobus S, N, & reliquum O tranſeant continuo rectæ E P S, D P O per polos E, D, ductæ, quæ conveniant in P: punctum illud P deſcribet lineam tertii ordinis, cum duplice puncto in polo E.

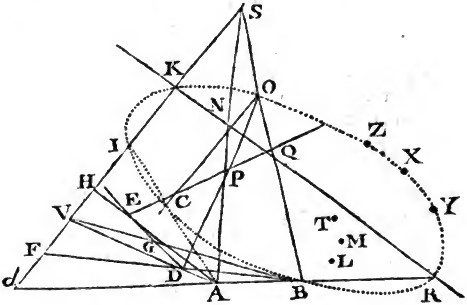


Simili modo deſcribi poſſunt Lineæ quarti ordinis. Moveantur circa quinque juncta data A, B, C, D, E, in plano quovis tanquam polos totidem rectæ A N S, B Q S, C N O, D P O, E P Q, quarum tres, A N S, B Q S, C N O ſibi occurrant in tribus punctis S, N, O; ducantur duo interſectionum puncta S, N, per rectas *d* K, R K poſitione datas, & interea per reliquum O tranſeat ſemper recta D P O mobilis circa quartum polum D, quæ ſecet rectam A N S in P; dein agatur per illud P recta E P Q ducta a polo quinto E, & producatur utrinque ut rectis B Q S, C N O, occurrat



in Q & W: dico puncta Q, W, Lineas quarti ordinis deſcribere. Demonſtratur ex *undecima Prop. Exerc. Geom.* Per polos A, E, & B, D, agantur rectæ A E H, BD F, rectæ *d* K poſitione datæ occurrentes in H, F; Jungantur D, E, atque per polos D, A, ducta A D, rectæ, *d*K occurrente in V; ex illo V educatur recta V B ad polum B quæ rectam D E ſecet in G. Figura deſcripta tranſibit per quinque puncta B, E, G, F, H, tripliciter autem per polum B. Producatur per polos A, B, recta A B R quæ rectæ K R poſitione datæ occurrat in R; Curva etiam tranſibit per puncta R, K.

Hinc elicitur methodus ducendi Lineam quarti ordinis per novem puncta data quorum unum ſit triplex. Dentur enim B,E,F,G,H,L,M,T,Q, & oportet unum B eſſe triplex. Jungantur puncta B F, F H, H E, producanturque rectæ BF, FH, HE. Et per puncta EG, GB, agantur rectæ EGD, BGV, quarum EGD rectam BF ſecet in D, altera vero BGV rectam FH in V. Junctiſque V & D ac producta VD



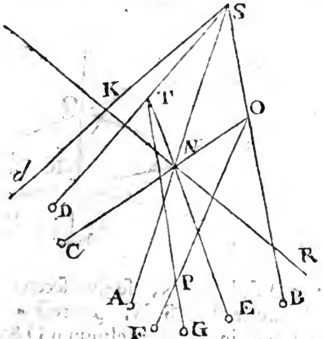
quæ rectæ HE occurrat in A, ducatur per puncta A, B, recta *d*ABR. Dein a punctis B, E, inflectantur ad datum Q rectæ BQS, EPQ, quarum prior BQS conveniat cum FH producta in S; & per puncta A, S, ducta AS occurrente rectæ EQ in P, per illud P ac D producatur recta DPO quæ rectæ BQS occurrat in O: Noteturque punctum O. Et ſimiliter ab iiſdem B, E, ad aliud datum T inflectantur rectæ BT*s* E*p*T (ſupple figuram) quarum BT*s* conveniat cum FH in *s*, & ducta A*s* ſecante rectam E*p*T in *p*, agatur per *p* & D recta D*p*Z quæ occurrat rectæ BT*s* in Z & notetur Z. Et ita deinceps ducantur rectæ ab iiſdem B, E, ad reliqua data M, L, ductiſque rectis ab A & D ut prius, notentur puncta inventa XY.

Deinde per quatuor puncta inventa O, Z, X, Y & datum B deſcribatur ſectio Conica (vid. *Prop.* 3. *Exerc. Geom*) quæ rectam FH ſecet in punctis I, K, rectam vero *d*AB in B, R. Per puncta A, I, agatur recta AI quæ ſectionem Conicam ſecet in I & C; junganturque puncta K, R, & producatur recta KR. Moveantur jam circa quinque puncta A, B, C, D, E, tanquam polos totidem rectæ AS, BS, CN, DO, EQ, quarum tres AS, BS, CN, ſibi occurrant in N, S, O, & ducantur concurſus N & S rectarum AS, CN, & AS, BS, per rectas KR, FHK, atque interea per polum D & concurſum O rectarum BS, CN tranſeat ſemper recta DPO quæ rectam AS ſecet in P; perque illud P & polum E producatur recta EPQ rectam BS ſecans in Q & hæc interſectio Q rectarum BS, EP deſcribet Lineam quarti ordinis tranſeuntem per novem data puncta BEFGHLMTQ quorum unum B fiet triplex.

Methodo haud multum diſſimili deſcribi poteſt Linea quarti ordinis per octo puncta data, quorum tria ſint duplicia, atque etiam Linea ejuſdem ordinis per undecim puncta data, quorum duo ſint duplicia, et alia plura hujuſmodi. Sed hæc ne nimiam tibi moram injiciam miſſa faciam: poſtea tamen explicaturus ſi non inutilia videantur.

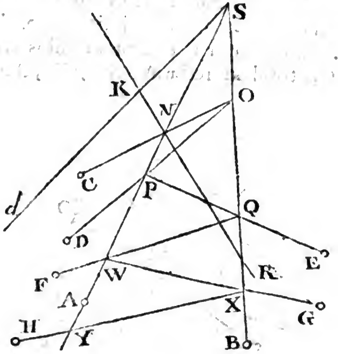
De numero autem punctorum quæ lineam cujuſcunque Ordinis determinant compertum habeo, ſi n ſit numerus dimenſionum Lineæ erit $n^2 + 1$ numerus punctorum per quæ linea deſcribi poteſt. *v. g.* Linea ſecundi ordinis per 5 puncta, tertii per 10, quarti per 17, quinti per 26. Atque hinc deducitur ſi Linea ordinis n ſit multiplici puncto $n - 1$ prædita deſcribi poteſt per $2n + 1$, *v. g.* Linea tertii ordinis cum duplici puncto, i. e. $n - 1 = 2$ per ſeptem puncta; Linea vero quarti ordinis cum triplici puncto per novem, *&c.* Et generaliter ſi p, q, r, &c. denotent puncta multiplicia quorum numerus ſit m, deſcribi poteſt Curva per $n^2 - p^2 - q^2 - r^2 + m + 1$ puncta, in quibus ſunt m multiplicia, *v. g.* Linea quarti ordinis quæ tria habet duplicia deſcribi poteſt per octo puncta; nam $n = 4$, $p = q = r = 2$, $m = 3$, & $16 - 4 - 4 - 4 + 3 + 1 = 8$.

Eſt & alia methodus a priori non multum abludens deſcribendi Lineas quarti ordinis, ſed paulo complicatior. Moveantur circa ſeptem polos, A, B, C, D, E, F, G, totidem rectæ A S, B S, C N, D S, E N, F O,



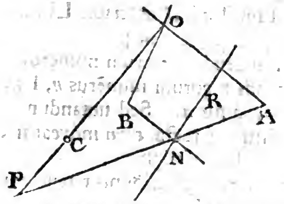
G T quarum una A N S revolvendo ſecet rectas *d*K, R K, poſitione datas in punctis S, N; ducantur per eorum unum N rectæ C N, E N, & per alterum S rectæ B S, D S, quæ rectis, C N, E N conveniant in punctis O, T, ut ſupra Sectiones Conicas deſcribentibus; & interea per eadem O, T, tranſeant rectæ F O, G T a polis F, G, ductæ quæ ſibi occurrant in P; concurſus P Lineam quarti ordinis deſcribet cum duplici puncto in utroque polo F & G.

Sed hiſce ne diutius immorer, en tandem Theorema Generale. Moveantur circa puncta A,B,C,D,E, F,G,H, &c. quorum numerus ſit *n*, tanquam polos, totidem rectæ AS,BS,CN, DP, EQ, FW, XG, H Y, &c. quarum tres A S, B S, C N, ſeſe interſecent in punctis N, S, O, ducantur duo S, N, per rectas *d* K, K R, poſitione datas; & interea per reliquum O & polum D tranſeat recta D P rectam A S ſecans in P, & per illud P & polum E ducta recta E Q quæ rectam B S ſecet in Q, & ex hoc Q per polum F agatur F Q rectamque A S ſecet in W, atque per W & polum G ducta W G rectam B S ſecante in X, & deinde per X & polum H producatur recta H Y quæ rectæ

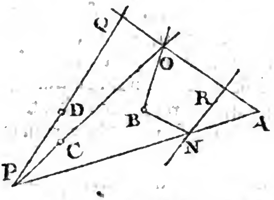


S A occurrat in Y, & ita deinceps; concurſus Y rectæ Y H ab ultimo polo H ductæ cum alterutra rectarum A S, B S deſcribet Lineam ordinis $n-1$; & Curva multiplex punctum $n-2$ habebit in polo A vel B prout fuerit deſcripta concurſu rectæ A S aut B S. Puncta O, P, Q, W, X, Y, &c. deſcribent lineas ordinis ſecundi, tertii, quarti, quinti, ſexti, ſeptimi, &c. at ſi locentur omnes poli A, B, C, D, E, F, G, H, &c. in eadem recta, puncta illa O, P, Q, W, X, Y, &c. etiam totidem rectas deſcribent.

Neutoniana deſcriptio Curvarum magnopere etiam hac methodo promovetur. Tu ſatis ſuperque noſti quod ſi circa data puncta A, B, rotentur dati anguli O A N, O B N, & interſectio N crurum A N, B N, ducatur per rectam N R poſitione datam; concurſum O crurum A O, B O, Sectionem Conicam deſcribere. Sumatur jam aliud punctum C circa quod moveatur recta O C P, quæ tranſeat ſemper per concurſum O crurum A O, B O & occurrat alteri cruri A N anguli A in P; concurſus P Lineam tertii ordinis deſcribet, dupliciter tranſeuntem per polum A. Et ſimiliter ſi concurſu cruris B N anguli B deſcribitur curva, ejuſdem erit ordinis, & duplex habebit punctum in polo B. Atque hinc etiam patet quomodo deſcribi poteſt Linea tertii ordinis per ſeptem puncta data quorum unum ſit duplex.



Moveantur ut prius anguli O A N, O B N circa data puncta A, B, & per concurſum O crurum O A, O B, tranſeat recta O C P ducta ab alio dato C quæ



cruri A N anguli A occurrat in P, dein per P & quartum datum D agatur recta P D Q cruri A O occurrens in Q; punctum illud Q deſcribit Lineam quarti ordinis cum triplici puncto in polo A.

Atque ita augendo polorum numerum A, B, C, D, &c. ut ſit tandem eorum numerus n, Linea deſcripta erit ejuſdem ordinis n. Sed notandum ſi pro angulo O B N ſubſtituatur recta quæ moveatur circa polum B, facilior evadet deſcriptio.

Hactenus Curvæ deſcribuntur tantummodo interſectione rectarum: Quibuſdam autem caſibus ſimplicior erit deſcriptio ope Linearum inferioris ordinis, & de his plurima Theoremata habeo quæ neſcio an tua obſervatione digna ſint, præſertim cum multa hujuſmodi in Exercitatione ſupra dicta jam explicantur. Denique enixe rogo ut benigne accipias & quæ minus accurate & inconcinne dicta ſint humaniter condones.

VII. *Extract of a Letter from* M. Geoffroy, Chemiſt, *Member of the* Royal Academy *of Sciences at* Paris, *and F. R. S. to Sir* Hans Sloane, *Bart. Preſident of the* Royal Society; *concerning Mr.* Seignette's SAL POLYCHRESTUS RUPELLENSIS, *and ſome other* Chemical Salts. *By* T. S. *M. D.*

Paris, May 4, 1732.

SIR,

WE have nothing new in *Chemiſtry* here, but the Diſcovery we have made of the Make of Meſſrs. *Seignette*'s *Sal polychreſtus Rupellenſis.* It is a *Tartarum ſolubile*, compoſed of Cream, or Cryſtals of *Tartar*; and the fix'd Salt of the *Kali* of *Alicante* well depurated. This Salt is very ſingular; for tho' it be a fix'd *Alkaline* Salt, it has the peculiar Property of cryſtalizing; nor does it eaſily diſſolve in the open Air, as other fix'd Salts do; but on the contrary, it calcines therein, like *Vitriols* or *Glauber*'s Salt. Another peculiar Property, which I have obſerv'd to belong to it, is, that if it be ſatiated with a *vitriolick* Acid, and the Liquor be evaporated, there reſults a Salt that has the Form of *Glauber*'s Salt, and all the Properties requiſite to make Meſſrs. *Seignette*'s Salt. In order to which, Take of the Salt of *Kali* well purified, 1℔. diſſolve it in Water, add thereto of *Cryſtals of Tartar* about 1℔ ß; boil the whole in order to diſſolve the *Cryſtals of Tartar*. But the exact Proportion of *Cryſtals of Tartar* can be no more determined in this Operation, than in making the *Tartarum ſolubile*; either becauſe the Salt of *Kali* has retain'd more or leſs Humidity in its Cryſtallization, or becauſe the *Tartar* has more or leſs Impurities in it. But if there be too much *Tartar* in the alcaline Liquor, after the Fermentation is over, filtrate the Liquor, and as it cools, the ſuperfluous *Tartar* will fall to the Bottom. After the Separation of the *Tartar* from the Liquor, evaporate the *Lixivium* by a gentle Heat, ſet it in a cool Place to cryſtallize, and you will have very fine *Cryſtals*. If the Liquor be evaporated a little too much, there will be no *Cryſtals* of Salt formed, but the Liquor will be converted into a hard tranſparent Maſs, not unlike Glue. But if you diſſolve this Maſs again, you may make it cryſtallize, as upon diſſolving *Seignette's* Salt.

This Salt purges very well, from one to two Ounces diſſolv'd in a Quart of Water.

Such is the Diſcovery of this Salt, which has hitherto paſſed for an *Arcanum*.

We have likewiſe his cryſtallized alcaline Salt, which is the Salt of *Kali*, that diſſolves not in the Air. I am actually at work in perfecting this Salt, in examining that of *Kali*; and comparing it with *Borax*. From this laſt I extract *Glauber's*

Salt, by mixing it with Oil of *Vitriol*. The Mixture of *Borax* ℥iv with Oil of *Vitriol*, ℥j ʒj upon Sublimation gives me the *Sal ſedativum* deſcribed by M. *Homberg*; and the Reſidue expoſed to a ſtrong Fire affords *Glauber*'s Salt. I have found out a Method to ſhorten this Operation; for inſtead of ſubliming this Salt, I get it by Cryſtallization in light foliated *Laminæ*. This Salt, whether ſublimated or cryſtallized, has the Property of diſſolving in Spirit of Wine; and if you ſet this Spirit of Wine on Fire, its Flame is green. Spirit of Wine has no Effect on *Borax*; the Oil of *Vitriol*, digeſted with Spirit of Wine, communicates no Greenneſs to its Flame: therefore it is requiſite that the *Borax* ſhould be united to an Acid, in order to produce this green Flame.

POSTSCRIPT.

I Send you a Specimen of Salt made of *Cryſtals of Tartar* and Lime Water, which Meſſ^rs. *Groſſe* and *Duhamel*, two Members of our Academy, have prepared; to which I join *Cryſtals* of *Seignette*'s Salt, that M. *Bolduc* and I have made ſeparately.

You will alſo find ſome *Sal Sedativum* made by Cryſtallization, which cryſtallizes in a peculiar Manner. This Operation is perform'd with ℥iv of *Borax*, and ℥i ʒi of concentrated *Oil of Vitriol*, the moſt fixt and weighty that can be had. The *Borax* is put into a Glaſs Retort, the Oil of *Vitriol* is poured on it, and then half an Ounce of common Water. This Mixture being expoſed to a Fire gradually encreaſed, after the Phlegm has paſſed off, and even while it is paſſing, there riſes Flowers, or a volatile Salt in very beautiful foliated *Laminæ*; ſome of which melt by the Heat of the Fire. After the Operation, the fineſt of theſe Flowers, which are round the Neck of the Retort, are gathered; and thoſe that are grey, are thrown upon the remaining Maſs: which Maſs is diſſolved in Water, filtrated, and evaporated ſlowly. Sometimes, even without Evaporation, the ſhining Talcous *Laminæ* are to be ſeen in the Liquor. In 24 Hours the Liquor is poured off theſe *Laminæ*: they are waſhed in fair Water, ſet to drain, and then to dry in a Stove.

If theſe *Cryſtals* do not calcine in the Stove, or in the Sun, 'tis a Sign there is nothing cryſtallized but the *Sal neutrum*: if they do calcine, 'tis a Sign that there is ſome *Glauber*'s Salt mixed. And then this Salt muſt be diſſolved again in hot Water, and recryſtallized. No body before me has thought of extracting this Salt by Cryſtallization: It was always ſublimed hitherto.

Printed for W. Innys and R. Manby, Printers
to the *Royal Society*, at the Weſt-End of St. *Pauls*.
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oyal Society, at the Weſt-End of St. *Paul's*.

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PHILOSOPHICAL TRANSACTIONS

For the Months of *April*, *May* and *June*, 1735.

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N. B. *The Model of this Machine, made by a Scale of an Inch to a Foot, was ſhewn the* Royal Society *the thirteenth Day of* June, 1734. *By Dr.* J. T. Deſaguliers, *F. R. S.* (Vide Tab.)

Fig. 1. Repreſents a Caſe D E C B, containing a Wheel of 7 Feet in Diameter, and 1 Foot thick; being a cylindrical Box, divided into 12 Cavities by Partitions directed from the Circumference towards the Center, but wanting 9 Inches of reaching the Center, being open towards the Center, and alſo towards the Circumference, and only clos'd at the Circumference by the Caſe, in which the Wheel turns by means of an Handle fix'd to its Axis A, which Axis turns in two Iron Forks, or half concave Cylinders of Bell-Metal, ſuch as A, fix'd to the upright Timber or Standard A E.

From the Middle of the Caſe on the other Side behind A, there comes out a Trunk or ſquare Pipe, which we call the Sucking-Pipe; which is continued quite to the upper Part of the ſick Perſon's Room, whether it be near or far from the Place where the Machine ſtands, in an upper or lower Story, above or below the Machine. There is a circular Hole in one of the circular Planes of the Machine of

18 Inches

18 Inches Diameter round the Axis, juſt where the Pipe is inſerted into the Caſe, whereby the Pipe communicates with all the Cavities; and as the Wheel is turn'd ſwiftly round, the Air which comes from the ſick Room, is taken in at the Center of the Wheel, and driven to the Circumference, ſo as to go out with great Swiftneſs at the Blowing-Pipe B, fix'd to the ſaid Circumference.

As the foul Air is drawn away from the ſick Rooms, the Air in the neighbouring Apartments will gradually come into the Room through the ſmalleſt Paſſages: But there is a Contrivance to apply the Pipes which go to the ſick Room to the Blowing-Pipe B, while the Sucking-Pipe receives its Air only from the Room where the Machine ſtands. By this means freſh Air may be driven into the ſick Room after the foul has been drawn out.

This Machine would be of great uſe in all Hoſpitals, and in Priſons: It would allſo ſerve very well to convey warm or cold Air into any diſtant Room; nay, to perfume it inſenſibly, upon occaſion.

Fig. 2. Repreſents the Inſide of the Flat of the Wheel which is fartheſt from the Handle, and next to the Sucking-Pipe.

1, 2, 3, 4. Repreſents the Cavity or Hole which receives the Air round the Axis, having about it a circular Plate of Iron to hold all firm; which Plate is made faſt to the Wood and to the Iron Croſs that has the Axis in it.

ggg, Denotes, by a prick'd Circle, a narrow Ring of thick Blanketting, which (by preſſing againſt the outſide Caſe, whilſt it is fix'd to the outſide of the Flat of the Wheel) makes the Paſſage into the Wheel tight.

HHH is another Circle of Blanketting, likewiſe fix'd to the outſide of the Wheel, and rubbing againſt the Caſe, that the Air violently driven againſt the inner Circumference of the Caſe, may have no way out, but at the Blowing-Pipe at B.

There is on the outſide of the other Flat of the Wheel, where the Handle is fix'd, a Ring of Blanketting, like HHH, oppoſite to it; but none oppoſite to *ggg*, becauſe the Wood there is not open, but comes home cloſe to the Axis.

Fig. 3. gives a vertical Section of the Wheel and Caſe a little forward of the Axis, drawn by a Scale twice as large as that of the other two Figures.

A *a*, the Axis ſupported by the Irons A, *a*, cylindrically hollow'd, except the upper Part, where a Pin keeps in the Axis.

BD, the Caſe with the Sucking-Pipe S *a*.

EA, the Prop for one End of the Axis.

1, 2, the Opening into the Wheel.

gg, the Eminence of the Wood to which is fix'd the ſmall Ring of Blanketting.

The four black Marks, one of which is near H, repreſent the Sections of the two other Rings of Blanketting.

II. *A Calculation of the* Velocity *of the* Air *moved by the new-invented* Centrifugal Bellows *of 7 Feet in Diameter, and 1 Foot thick within, which a Man can keep in Motion with very little Labour, at the Rate of two Revolutions in one Second.* *By* J. T. Deſaguliers, *F. R. S.*

WHEN the Wheel revolves upon its Axis, which is performed in this Machine every Revolution in about half a Second, the Air may be conſidered as divided into as many concentrical Circumferences as there are Particles of Air contained between the leaſt and the greateſt Circle, conſequently the centrifugal Forces will be as the Radii; that is in an arithmetical Progreſſion.

Ft.

Let $R =$ Radius of the greateſt Circle 3. 5

$r =$ Radius of the leaſt Circle 0. 75

$m =$ Radius of the middle Circle 2. 125 $= r + \frac{R - r}{2} = \frac{R + r}{2}$.

$v =$ Velocity or Space deſcribed in a Second in the middle Circle, upon the Suppoſition that the Wheel revolves two Revolutions in a Second. } 26. 21

$S =$ Space deſcribed in a Second by the Action of Gravity. } 16. 1

s =

$s =$ Space that a Particle of Air receding from the Center would deſcribe in a Second by the Action of the centrifugal Force at the Circumference of the middle Circle.

$2m : v :: v : s$; therefore $\frac{vv}{2m} = s$. by *Huyghens's* Rule. Let G and c, expreſs the Force of Gravity, and the centrifugal Force at the middle Circle. Since the Spaces deſcribed in the ſame Time by the Action of two Forces are as thoſe Forces $S : s :: G : c$, and $\frac{sG}{S} = c$, and ſubſtituting in this Expreſſion $\frac{vv}{2m}$ inſtead of s, we have $\frac{vvG}{2mS} = c$; and putting $\frac{R+r}{2}$, inſtead of its equal m, $\frac{vvG}{\overline{R+r}\times S} = c$. So that the Ratio of Gravity to the centrifugal Force, at the middle Circle, is that of G to $\frac{vvG}{\overline{R+r}\times S}$ or that of 1 to $\frac{vv}{\overline{R+r}\times S}$; which being multiplied by the Number of the revolving Circles $R - r$, gives for the Preſſure of the Column of Air $R - r$ proceeding from Gravity $R - r$, and the Preſſure proceeding from the centrifical Forces $\frac{\overline{R-r}\times vv}{\overline{R+r}\times S}$, wherein $R - r$ being a Factor common to both, may be thrown out of the Expreſſion: And ſince the Velocities produced from different Preſſures are as the ſquare Roots of the Preſſures, the Velocity Gravity would give from the natural Weight or Preſſure of

$R - r$

$\overline{R-r}$ will be to the Velocity the ſame Column would have from the Preſſure occaſioned by the centrifugal Force, as $\sqrt{1}$, or 1 to $\sqrt{\frac{vv}{\overline{R-r}\times S}}$.

Laſtly, Since the Velocity proceeding from the Action of Gravity upon a Column $= R - r$, is always a known Quantity; it may be call'd $= a$ (equal in this Caſe to 15. 38 Ft. *per* Second) and conſequently the Preſſure proceeding from the centrifugal Force will be $a \times \sqrt{\frac{vv}{\overline{R-r}\times S}}$ or, $av \times \sqrt{\frac{1}{\overline{R-r}\times S}}$ or, $\frac{av}{\sqrt{\overline{R-r}\times S}}$: That is, in this Machine $\frac{15.38 \times 26.71}{\sqrt{4.25 \times 16.1}} = 49.67$ Ft. *per* Second. And if we add to this the Velocity of the outer Circle in the Tangent of which the Air eſcapes, which (in the Suppoſition we made of two Revolutions in a Second) is 44 Feet *per* Second, we ſhall have $= 93.67$ Feet *per* Second.

N. B. This Calculation ſuppoſes the Bore of the Sucking-Pipe ſufficiently great to furniſh as much Air as would eſcape, according to this Velocity; but in this Machine the Sucking-Pipe being no greater than the Ajutage or Blowing-Pipe, the Velocity proceeding from the Preſſure occaſioned by the centrifugal Force, and from the Velocity in the the Tangent (which may be repreſented by a Column of Air of ſufficient Height to give the Velocity of 93.67 Ft. which is 145.882 Ft.) muſt be divided into two equal Parts, one half employed in ſucking, and the other in blowing; therefore the Half of 145. 882 Feet, which is 72. 941 Feet, will repreſent the Height of a Column of Air, that would occaſion the ſame Preſſure with which the centrifugal Force and the circular Motion act in this Machine; and a Column of this Height producing a Velocity of 68. 53 Feet *per* Second. This Number will expreſs the Velocity with which the Air is ſucked into the Wheel; and the ſame Number will alſo expreſs the Velocity of the Air out of the Blower, proceeding from the centrifugal Force, and the circular Velocity of the outer Circle, which is the real Velocity of the Stream of Air out of the Blower of this Machine, *viz.* 68. 53 Feet *per* Second, which is at the Rate of a Mile in about 77 Seconds, or about 7 Miles in 9 Minutes.

III. *The* Uſes *of the foregoing* Machine, *communicated in a Letter to* Cromwell Mortimer, *M. D. R. S. Secr.* Feb. 23, 173$\frac{6}{7}$. *from the ſame.*

S I R,

ACcording to my Promiſe I ſend you a further Account of my centrifugal Wheel, which is now fix'd in a Room above the Houſe of Commons, to draw away the hot Steam ariſing from the Candles, and the Breath of the Company in the Houſe, when it is very full, in warm Weather; as alſo afterwards to drive in a Stream of freſh Air, to ſpread uniformly all over the Houſe, by coming in at the middle of the Cieling.

The Uſes of this Machine for ſick Rooms, for Priſons, for warming, cooling, or perfuming any Chambers at a diſtance, were ſpoken of in the Explanation of the Model I ſhew'd the Society. The Machine may alſo ſerve in a Man of War, to take away the foul Air between Decks, occaſion'd by the Number of Men in the Ship, and to give them freſh Air in a few Minutes. In every Part of the Veſſel every foul Hole may be render'd wholeſome, and even the Stench and foul Air from the Surface of the Bulge-Water may be carried of. In regard to Mines, the Machine muſt prove of excellent Uſe; for as the Damps (either fulminating, which taking Fire, deſtroy the Men and ruin the Works, or arſenical, which kill by their poiſonous Nature) are ſome ſpecifically lighter, and ſome ſpecifically heavier than common Air, this centrifugal Wheel can in a little Time drive down Air through wooden Trunks (or Launders) of ſeven Inches bore, in ſuch Quantities into the deepeſt Mines, as to cauſe all the light Damp to come out at the Top of the Pit; or, by only altering two Sliders, ſuck away all the heavy poiſonous Damp, whilſt wholeſome Air goes down from above Ground into the Pit, ſo as to fill all the ſubterraneous Caverns with freſh and wholeſome Air.

Likewiſe a great many of the Difficulties which attend the carrying on ſubterraneous Paſſages for the Conveyance of Water from Mines (call'd Soughs, Adits, or Drifts) may be remov'd by the Help of this

Wheel; for the freſh Air may be driven in a very little Time to the Place where the Men are at work, though at the Diſtance of 2, 3, or 4 Miles, and therefore alſo to any intermediate Space; whereas the Practice now is, either to make a double Drift with Communications between the two for the Circulation of the Air, or to ſink perpendicular Shafts or Pits from the Top of the Hill over the Adit; both which Methods are very expenſive, and (I dare ſay) will, upon Tryal, be out-done by the Application of my Machine. *I am,*

S I R,

Your moſt humble Servant,

J. T. Deſaguliers.

IV. *The Caſe of a* Cataleptick Woman: *Communicated to the* Royal Society *by* Richard Reynell, *Apothecary,* London.

ANN Bullard, a Servant, about one and twenty Years of Age, had been for ſome time irregular in her *Menſes*, and very much afflicted for the Loſs of a Friend. *July* the Tenth, 1730. ſhe complained of a Pain in her Head, Sickneſs in her Stomach, with a general Diſorder ; and took *Gaſcoign*'s Powder for a Sweat : Next Morning, *July* the Eleventh, about Nine o'Clock, ſhe was found in Bed, ſenſeleſs, ſtiff, and void of Feeling, with her Eyes ſhut ; and, upon the firſt Surprize, it was thought ſhe was dead. When I came, I found her in a true *Cataleptick Fit*, ſenſeleſs, without Motion, her Limbs very ſtiff, but warm, and not eaſy to be bent ; but in whatever Poſture any Limb was put, it continued in the ſame, whether erect, or reclined : Her Reſpiration was good, but her Pulſe low, and irregular ; ſhe had no Catchings, or convulſive Motions, but could not, by any Means uſed, be brought to herſelf (in any reſpect.) A Vein was opened in the Arm, and twelve Ounces of Blood taken away ; ſhe bled freely, and came a little to herſelf, but could not ſpeak. I then gave her this Draught : ℞ *Aq. Menth. Rutæ. Bryon. Co.* ā. ʒvj. *Sal. volat. Corn. C.* ℈ſs. *Sacchar. Albiſſ.* ℈ij. *f. hauſt.* and five Spoonfulls at pleaſure of the following Julep : ℞ *Aq. Puleg. Rutæ. Menth.* ā. ℥ij. *Aq. Bryon. Co. Nephrit.* ā. ℥iſs *Tinct. Caſtor.* ʒij. *Sacchar. Albiſſ. q. ſ. f. Julapium.* In a few Hours ſhe came to herſelf: I then asked her, whether ſhe knew how ſhe was taken ? She replied, that ſhe had been reſtleſs and uneaſy till about Four o' Clock in the Morning, when ſhe believed ſhe fell into the Diſorder ſhe was found in ; but remember'd nothing that had happened beſides. She complained of a Dizzineſs in her Head, with a violent Pain in the Fore-part of it, and Sickneſs in her Stomach, and was a little feveriſh. I gave her the following Vomit at Four o'Clock in the Afternoon : ℞ *Aq. Cardui* *bened.* ℥j. *Pulv. Ipecacuanh.* ʒß. *Vitriol. alb. depurat.* gr. vj. *Oxym. Scillit.* ʒiß *f. hauſt.* The Vomit work'd kindly, and ſhe ſeemed relieved by it: About Six o'Clock in the Evening another Fit returned, much in the ſame Manner as before; but ſhe ſoon came out of it, and then took the Draught with the Volatile Salt of Harts-horn, as before; and I applied a large Bliſter to her Back, and two more to her Arms: About Nine the ſame Evening ſhe had a ſtrong Convulſion Fit, with Catchings, Grinding of the Teeth, and a great Tremor, neither of which ſhe had had before: ſhe had a Stool the preceding Night, but none that Day. I gave her the Draught as follows, at Night going to reſt: ℞ *Tinct. Hier. cum Vino fact* ℥ij. *Aq. Menth.* ʒvj. *Spt. Lavend. Co.* ʒß *f. hauſt.* and ſhe continued taking the Draught, with the Volatile Salt, &c. every four Hours. *July* the Twelfth, ſhe had been light-headed all Night, with little or no Reſt; the Bliſters were dreſſed, which diſcharged plentifully, and the Tincture had given her three Stools in the Night, which had made her a little faint; her Pulſe was low, and her Water pale. I ſaw her in the Evening, when ſhe had ſlept pretty well, with which ſhe was refreſhed; the Pain in her Head but little, her Stomach eaſy, and I found her in every reſpect better. The Draughts were continued every ſix Hours, and ſhe took of the Julep before mentioned, when faint or ill. *July* the Thirteenth in the Morning, I found her Head eaſy, her Water higher coloured; ſhe was allowed Broth, and Food of eaſy Digeſtion, which agreed very well with her: She ſate up in the Afternoon, but was faint,

and

and her Head giddy; but when in Bed, ſhe was better: She had no Stool that Day. I gave her a Draught with the Volatile Salt, *&c.* at Night going to reſt, and the following Purge the next Morning ℞ *Tinct. Hier. cum Vino fact.* ℥iß *Syr. è Spina Cerv. Aq. Puleg. ā.* ʒvj *Spt. Lavend. Co.* ʒj *f. hauſt. cum regimine cap. July* the Fourteenth, the Purge worked five times; ſhe eat a light Dinner, and was eaſy; but upon walking about the Room, her Head was giddy, and ſhe trembled very much, but when in Bed, ſhe was better. I gave her the following Draught at Night going to reſt: ℞ *Aq. Rutæ Puleg. Bryon. Co. ā.* ʒvj. *Spt. Corn. C. opt. gutt.* 40. *Tinct. Caſtor.* ʒj. *Sacchar. Albiſs. paululum f. hauſt. July* the Fifteenth ſhe complained, when up, of a Numbneſs in her Legs, and a Pricking in them, like to what happens when the Legs are what we commonly call aſleep: Her Appetite was better, and ſhe was in every reſpect amended. She took the following Medicines: ℞ *Pulv. rad. Valerian Sylv.* ℈ij. *P. Caſtor. Ruſſ.* ℈j. *Aſæfœtid.* ʒj. *Tinct. Caſtor. q. s. f. Maſſa Pilular. cujus formentur Pilul. No.* 40. of which ſhe took four twice a day with a ſmall Draught of this Julep: ℞ *Aq. Ceraſ. Nigr.* ℥vj. *Aq. Rutæ. Pæon. Co. ā.* ℥ij. *Spt. Lavend. Co.* ʒvj. *Syrup. Caryoph. q. s. f. Julap.* of which ſhe took likewiſe five Spoonfuls at pleaſure. The Bliſters were kept running as long as we could; and when they were dried up, *July* the Nineteenth, I gave her the ſame Purge as before. *July* the Twenty-ſecond, ſhe had continued very well, without any Return of a Fit; but upon cutting an Iſſue in her Arm, ſhe fell into a third Fit, in which ſhe continued near two Hours, but then came to herſelf, and was well that Evening. *July* the Twenty-ninth the Purge was repeated. *Auguſt* the Sixth ſhe complained of a Pain in her Head, Sickneſs in her Stomach, and ſome Days before, ſhe had a Shew of the *Menſes*, and had vomited near a Pint of Blood, and was coſtive: I then adviſed her to take two Spoonfuls of *Tinctura Sacra*, every or every other Night going to Bed, as ſhe found it neceſſary, and forty of the following Drops: ℞ *Spt. C. C. opt.* ʒiij. *Tinct. Helleb. Nigr.* ʒv. to be taken twice a Day in Chamomile-Tea. She took theſe Medicines about three Weeks, which anſwered Expectation, and I left her well. I ſaw her about twelve Months after, and ſhe told me, ſhe had continued very well ever ſince.

> “ Catalepſis tam rarus affectus eſt, ut credant inter centum, imò Sexcentos, vix unum Medicum reperiri, qui Catalepticum aliquem viderit; ideóque Hiſtoriæ Catalepticorum, ſi occurrant, diligenter annotandæ.
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> SENNERTUS, *Med. Pract. lib.* I. *c.* 30.

V. *Some Thoughts on the Operation of the* Fiſtula lacrymalis. *By* Francis-Joſeph Hunauld, *M. D. F. R. S. Regius Profeſſor of Anatomy and Surgery, and Member of the* Royal Academy of Sciences *at* Paris. *Communicated to the* Royal Society *in a Letter to* Tho. Stack, *M. D.*

I Omit giving the Hiſtory of the *Fiſtula lacrymalis*, of the different Species of the Diſtemper, or the various Methods of treating it, as Things ſufficiently known; and ſhall only remark, that the Intention in deſtroying the *Os unguis*, and *Saccus lacrymalis*, through which the Tears naturally deſtil into the Noſe, is to procure them a new Paſſage thither, by the Hole thus artificially made. Wherefore, in order to keep the Sides of this Hole aſunder, to prevent its filling up, and render the Fleſh, which forms its Circumference, hard, and as it were callous, a Tent made of prepared Sponge, &c. is put into this new Paſſage, and is continued therein a Month or two. However, this Precaution, notwithſtanding it happens but too often, that the Tears, inſtead of keeping the Road prepared for them with ſuch Care, flow over the lower Eye-lid, as before the Operation, and occaſion a Weeping, which is now become paſt Remedy.

'Tis eaſy to prove, that thoſe very Means, which are uſed after the Operation to make the Tears deſtil into the Noſe, are generally the Cauſe of the ſubſequent Weeping: For by filling the Wound with ſmall Pledgets, and putting a Tent into the Hole that was made, the Orifice of the little common Canal, that ſerves to convey the Tears into the *Ductus lacrymalis*, ſuffers a Compreſſure, and is render'd hard, thick and callous; whereby, as its Diameter is very ſmall, it is eaſily ſtopp'd up. The Contuſion made on this little Orifice, and round about it, brings on a Suppuration; after which the Parts coaleſce, and the Orifice of this ſmall Canal cloſes up. The *Pus* or *Sanies*, that in the Courſe of the Diſtemper flow'd back both through the common Canal, and the ſmall Canals, which are a Continuation of the *Puncta lacrymalia*, has ſometimes occaſion'd Excoriations; in conſequence of which happens a Regeneration of Fleſh during the Dreſſings, a ſmall matter whereof is ſufficient to ſtop up ſuch ſlender Ducts. In fine, thoſe ſmall Canals, through which nothing paſſes for a Month or two, that the Dreſſings laſt, either cloſe by their proper Springineſs, or their Diameters are leſſen'd by their ſmall Veſſels becoming varicous. 'Tis certain, that Injections are ſometimes made through the *Puncta lacrymalia*; but the propelling Force of theſe Injections overcomes thoſe Reſiſtances, which the Cauſe that naturally drives the Tears into the *Puncta lacrymalia*, is not in a Condition to get the better of.

Thus it appears from the Detail of the Accidents I have enumerated, and which generally happen, more or leſs, that while the Artiſt is endeavouring to preſerve a clear Paſſage for the Tears into the Noſe, he labours, without deſigning it, to ſtop the

Entry of the upper Part of their Canal. I hope now to make appear, that the beſt way to avoid part of theſe Accidents, and keep open the new Canal from the Eye to the Noſe, is preciſely to do nothing. This is what Experience has confirm'd me in, and what likewiſe Theory, well underſtood, will give us a clear Conception of.

'Tis a Thing not very eaſy to determine, how the Tears, and the Liquid that is continually found on the Surface of the Eye, in order to preſerve the Cleanneſs and Tranſparency of the *Cornea*, can paſs through the *Puncta lacrymalia.* 'Tis moreover obſerved, that when one lies in Bed, this Liquid enters into thoſe *Puncta lacrymalia,* which in that Poſition are higher than the Eye, as well as into the *Puncta lacrymalia* of the oppoſite Eye. The Aſcent of Liquors in capillary Tubes above the Level, might be propoſed to explain this laſt Fact. One might alſo in certain Circumſtances imagine the Road which the Tears keep, to paſs from the Eye into the Noſe, to be a *Syphon*, the ſhort Leg of which is divided into two. 'Tis ſtrange that theſe two Ideas, which ſtrike by their Simplicity, have not been offer'd by any one hitherto. It muſt be allow'd, however, that they are not entirely ſufficient to account for the *Phænomenon* under Conſideration. The following *Rationale* ſeems to me quite as ſimple, and more accurate.

The Air preſent at the Orifices of all the Ducts, which have any Communication with the *Trachæa*, is by its proper Weight determined to enter them, when the Reſiſtance happens to be diminiſh'd. Thus as, during Inſpiration, it paſſes through the Mouth and Noſtrils, ſo it likewiſe enters the *Puncta lacrymalia*; and muſt neceſſarily carry with it, towards the *Puncta lacrymalia* and their ſmall Canals, the Moiſture that lubricates the Surface of the Ball of the Eye, as it mixes with it. Therefore it is eaſy to perceive already, that in order to preſerve to the Tears their new and artificial Road into the Noſe, one need only commit the whole Care to the continual Paſſage of the Air and Tears. 'Tis well known in good Surgery, that 'tis very difficult, not to ſay impoſſible, to effect a re-union in a Part, that ſerves as an Emunctory to a Liquor conſtantly flowing to it.

Now let us examine, if Nature alone can ſtop the Hole made by the Operation. It will not be imagined, that from the Remains of a bony *Lamina*, ſo thin as the *Os Unguis*, a ſufficient Quantity of oſſifying Juice can work out to ſtop it up. The *Perioſtium* and *Saccus lacrymalis* are too much lacerated, to think it poſſible for them to repair of themſelves what they had loſt. Nor will it be believed, that the *Membrana pituitaria* can eaſily fill up the Hole made in it. Thoſe are the Parts concern'd in the Operation: But even if they are granted to be more diſpoſed to a Re-production than they really are, ſtill the Air and Tears will always be able to preſerve themſelves a Paſſage into the Noſe.

Wherefore, after having deſtroy'd the *Saccus lacrymalis* and *Os Unguis*, inſtead of introducing an extraneous Body capable of making the Orifice of the ſmall common Canal into the *Ductus lacrymalis* become callous, and of drawing on a Suppuration, the Communication between the Noſe and Eye muſt be left entirely diſengaged, and Liberty by this means be given to Reſpiration to make both the Air alone, and the Air mix'd with the Tears, to paſs continually through it.

In fine, the Action of theſe Fluids may be aſſiſted by the Application of *Collyriums*, and by making frequent Injections into the *Puncta lacrymalia*; which, beſides the common Effects that may be naturally expected from them, will contribute to prevent the Juice, that re-unites the Wound made in the Skin, from over-ſtreightening the Canal.

VI. *Concerning* the Cauſe *of the* General Trade-Winds: *By* Geo. Hadley, *Eſq*; *F. R. S.*

I Think the Cauſes of the General Trade-Winds have not been fully explained by any of thoſe who have wrote on that Subject, for want of more particularly and diſtinctly conſidering the Share the diurnal Motion of the Earth has in the Production of them: For although this has been mention'd by ſome amongſt the Cauſes of thoſe Winds, yet they have not proceeded to ſhew how it contributes to their Production; or elſe have applied it to the Explication of theſe Phænomena, upon ſuch Principles as will appear upon Examination not to be ſufficient.

That the Action of the Sun is the original Cauſe of theſe Winds, I think all are agreed; and that it does it by cauſing a greater Rarefaction of the Air in thoſe Parts upon which its Rays falling perpendicularly, or nearly ſo, produce a greater Degree of Heat there than in other Places; by which means the Air there becoming ſpecifically lighter than the reſt round about, the cooler Air will by its greater Denſity and Gravity, remove it out of its Place to ſucceed into it its ſelf, and make it riſe upwards. But it ſeems, this Rarefaction will have no other Effect than to cauſe the Air to ruſh in from all Parts into the Part where 'tis moſt rarefied, eſpecially from the North and South, where the Air is cooleſt, and not more from the Eaſt than the Weſt, as is commonly ſuppoſed: So that, ſetting aſide the diurnal Motion of the Earth, the Tendency of the Air would be from every Side towards that Part where the Sun's Action is moſt intenſe at the Time, and ſo a N. W. Wind be produced in the Morning, and a N. E. in the Afternoon, by Turns, on this Side of the Parallel of the Sun's Declination, and a S. W. and S. E. on the other.

That the perpetual Motion of the Air towards the Weſt, cannot be derived meerly from the Action of the Sun upon it, appears more evidently from this: If the Earth be ſuppoſed at Reſt, that Motion of the Air will be communicated to the ſuperficial Parts, and by little and little produce a Revolution of the Whole the ſame Way, except there be the ſame Quantity of Motion given the Air in a contrary Direction in other Parts at the ſame Time, which is hard to ſuppoſe. But if the Globe of the Earth had before a Revolution towards the Eaſt, this by the ſame means muſt be continually retarded: And if this Motion of the Air be ſuppoſed to ariſe from any Action of the Parts of it on one another, the Conſequence will be the ſame. For this reaſon it ſeems neceſſary to ſhew how theſe Phænomena of the Trade-Winds may be cauſed, without the Production of any real general Motion of the Air weſtwards. This will readily be done by taking in the Conſideration of the diurnal Motion of the Earth: For, let us ſuppoſe the Air in every Part to keep an equal Pace with the Earth in its diurnal Motion; in which Caſe there will be no relative Motion of the Surface of the Earth and Air, and conſequently no Wind; then by the Action of the Sun on the Parts about the Equator, and the Rarefaction of the Air proceeding therefrom, let the Air be drawn down thither from the N. and S. Parts. The Parallels are each of them bigger than the other, as they approach to the Equator, and the Equator is bigger than the Tropicks, nearly in the Proportion of 1000 to 917, and conſequently their Difference in Circuit about 2083 Miles, and the Surface of the Earth at the Equator moves ſo much faſter than the Surface of the Earth with its Air at the Tropicks. From which it follows, that the Air, as it moves from the Tropicks towards the Equator, having a leſs Velocity than the Parts of the Earth it arrives at, will have a relative Motion contrary to that of the diurnal Motion of the Earth in thoſe Parts, which being combined with the Motion towards the Equator, a N. E. Wind will be produc'd on this Side of the Equator, and a S. E. on the other. Theſe, as the Air comes nearer to the Equator, will become ſtronger, and more and more Eaſterly, and be due Eaſt at the Equator itſelf, according to Experience, by reaſon of the Concourſe of both Currents from the N. and S. where its Velocity will be at the rate of 2083 Miles in the Space of one Revolution of the Earth or Natural Day, and above 1 Mile and $\frac{1}{3}$ in a Minute of Time; which, is greater than the Velocity of the Wind is ſuppoſed to be in the greateſt Storm, which according to Dr. *Derham's* Obſervations, is not above 1 Mile in a Minute. But it is to be conſidered, that before the Air from the Tropicks can arrive at the Equator, it muſt have gained ſome Motion Eaſtward from the Surface of the Earth or Sea, whereby its relative Motion will be diminiſhed, and in ſeveral ſucceſſive Circulations, may be ſuppoſed to be reduced to the Strength it is found to be of.

Thus I think the N. E. Winds on this Side of the Equator, and the S. E. on the other Side, are fully accounted for. The ſame Principle as neceſſarily extends to the Production of the Weſt Trade-Winds without the Tropicks; the Air rarefied by the Heat of the Sun about the Equatorial Parts, being removed to make room for the Air from the cooler Parts, muſt riſe upwards from the Earth, and as it is a Fluid, will then ſpread itſelf abroad over the other Air, and ſo its Motion in the upper Regions muſt be to the N. and S. from the Equator. Being got up at a Diſtance from the Surface of the Earth, it will ſoon loſe great Part of its Heat, and thereby acquire Denſity and Gravity ſufficient to make it approach its Surface again, which may be ſuppoſed to be by that Time 'tis arrived at thoſe Parts beyond the Tropicks where the weſterly Winds are found. Being ſuppos'd at firſt to have the Velocity of the Surface of the Earth at the Equator, it will have a greater Velocity than the Parts it now arrives at; and thereby become a weſterly Wind, with Strength proportionable to the Difference of Velocity, which in ſeveral Revolutions will be reduced to a certain Degree, as is ſaid before, of the Eaſterly Winds, at the Equator: And thus the Air will continue to circulate, and gain and loſe Velocity by Turns from the Surface of the Earth or Sea, as it approaches to, or recedes from the Equator. I do not think it neceſſary to apply theſe Principles to ſolve the Phænomena of the Variations of theſe Winds at different Times of the Year, and different Parts of the Earth; and to do it would draw this Paper into greater Length than I propoſe. From what has been ſaid it follows:

Firſt, That without the Aſſiſtance of the diurnal Motion of the Earth, Navigation, eſpecially Eaſterly and Weſterly, would be very tedious, and to make the whole Circuit of the Earth perhaps impracticable.

Secondly, That the N. E. and S. E. Winds within the Tropicks muſt be compenſated by as much N. W. and S. W. in other Parts, and generally all Winds from any one Quarter muſt be compenſated by a contrary Wind ſome where or other; otherwiſe ſome Change muſt be produced in the Motion of the Earth round its Axis.

VII. *An Account of the ſeveral* Earthquakes *which have happen'd in* New-England, *ſince the firſt Settlement of the* Engliſh *in that Country, eſpecially of the laſt, which happen'd on* Octob. 29, 1727. *Communicated to the* Royal Society *by* Paul Dudley, *Eſq; F. R. S. in a Letter to the Secretary.* *

SIR, *Roxbury*, *Nov.* 13, 1727.

YOU will doubtleſs from the publick Prints have an Account of the terrible Earthquake that happen'd here on the 29th of *October* laſt in the Night; however, I think it my Duty, and hope it will be acceptable to the Society, to have the Particulars from one of their own Members.

That this Country is ſubject to Earthquakes is certain; and we have been often admoniſhed of it ſince the firſt Settlement of the *Engliſh* here, which now is about an hundred Years. Our printed Books and other good Records have taken notice of the moſt remarkable that have happen'd. The firſt and moſt conſiderable Earthquake that I find in our Hiſtory, and which ſeems to have been much like our laſt, was on the Second of *June*, 1638. This is ſaid (by the Author, who was a Gentleman of Character and Probity) " to have been a great and

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* See likewiſe an Account of this ſame *Earthquake* in *Tranſact.* N° 409. p. 124.

" fearful Earthquake: It was heard before it came, " with a rumbling Noiſe or low Murmur like unto " remote Thunder; it came from the Northward, " and paſſed Southward; as the Noiſe approached " near, the Earth began to quake; and it came " at length with that Violence, as cauſed Platters, " Tyles, &c. to fall down; yea, People were afraid " of their Houſes. The Shock was ſo violent and " great, as that ſome being without-doors, could " not ſtand, but were fain to catch hold of " Poſts, &c. About half an Hour after, or leſs, " came another Noiſe and Shaking, but not ſo loud " nor ſtrong as the former: Ships and Veſſels in " the Harbour were ſhaken, &c." In 1658, there was another very great Earthquake, but no Particulars related. In 1660, *January* 31ſt, a great Earthquake. In 1662, *January* 26th, about Six o'Clock at Night, there happen'd an Earthquake, which ſhook the Houſes, cauſed the Inhabitants to run out into the Streets, and the Tops of ſeveral Chimnies fell down. About the Middle of the ſame Night was another Shake; alſo in the Morning following the Earth ſhook again. In 1665, and in 1668, and 1669, the Earth was ſhaken; ſince which we have alſo had ſeveral Tremors of the Earth, but not very conſiderable; ſo that our People began to hope we ſhould hear no more of them. But we are now convinced to purpoſe, that *New-England* is ſtill liable to the ſame Terror and Deſolation that other Countries are from theſe extraordinary Motions of the Earth.

I now proceed to give the beſt Account I can of our late terrible Earthquake, which has ſo juſtly amazed and terrified the Inhabitants from one End of the Country to the other. The firſt Thing I ſhall begin with is to give a ſhort Account of the Weather or Seaſon preceding the Earthquake: Our Winter in *January* and *February* was very moderate, and excepting a few cold Days, the Weather was pleaſant, and no great Froſt in the Ground. In the beginning of *March* we had a great deal of Snow, and ſome cold Weather, which ſoon went over; and on the 11th Day, 15 Minutes after Four o'Clock, the Sun was eclipſed about five Digits, as near as I could make it without an Inſtrument; after which to the End of the Month we had pleaſant Weather, Rain at times, and once we had Thunder and Lightning. *April* for the moſt part had fair pleaſant Spring Weather, and a plentiful Rain in the beginning and latter end of the Month. The Beginning of *May* was alſo pleaſant Weather; the 9th, 10th, and 13th a great deal of Rain: The 18th a white Froſt: 24th and 25th cold Weather; from thence to the End of the Month very dry. The Beginning of *June* the ſame; abundance of Thunder and Lightning at times during the whole Month. In *July* alſo, though we had ſome Showers in different Places, yet in general it was a very dry Seaſon, and a great deal of Thunder and Lightning alſo this Month; the three laſt Days of it ſo violent hot, that there was no working or travelling by Day, or ſleeping by Night: The Beginning of *Auguſt* was alſo exceeding hot, and in particular the firſt Day at Night from the Evening to Midnight we had a continued Coruſcation or Lightning all round the Horizon; the like ſcarce ever remember'd: it was truly terrible, though the Thunder was not ſevere. Dry Weather continued to the 10th, and then we had a plentiful Rain all over the Province, but our hot Weather held on to the End of the Month; and till about the Middle of *September* we had very hot Weather: So that take it all together, I have never known ſo much hot Weather in any one Summer in my Time On the 16th of *September* we had ſuch a violent Storm from the North-Eaſt, as was never remember'd, for the Fierceneſs and Strength of the Wind; it blew down Houſes, Barns, and an infinite Number of Trees in our Orchards and Woods; a great deal of Rain alſo then fell. In the Month of *October*, preceding the Earthquake, we had a pretty deal of cold Weather; on the 23d a great deal of Rain, with the South Wind; on the 25th at Night, a hard Froſt; on the 26th winteriſh Weather, and a little Snow; 28th cold, the Wind at North-Weſt: Lord's-day 29th, the Wind at North-Weſt, though little of it, but cold; in the Evening quite calm and a clear Sky.

By this ſhort Journal of the Weather the Learned will be able in ſome meaſure to ſay, how far our Earth might be diſpos'd to, or prepar'd for the Earthquake that followed; firſt by a long continued Drought and extreme Heat, whereby the Earth became more porous, and abounded with Exhalations or Vapours inflamed, and which afterwards being ſhut up by the ſucceeding great Rains and Froſt, and thereby hinder'd from an ordinary and eaſy Paſſage through the Pores and common Vents of the Earth, worked ſo much more forcibly and terribly upon one another. But Philoſophers not being yet agreed on the Nature or certain Cauſes of Earthquakes, I paſs on to the ſecond Thing which I propoſed to enquire into, *viz.* what Kind or Sort of Earthquake ours was. *Gilbertus Jacchæus* in his *Inſtitutiones Phyſicæ, cap. Terræ Motus* diſtinguiſhes Earthquakes into four Species; wherein he agrees with *Ariſtotle* and *Pliny*, with whom the firſt Species is a Shake or Trembling, and by them liken'd to the ſhaking Fit of an Ague. I cannot yet hear of any Breach or Opening of the Earth, through the whole Extent of our Earthquake. It has been ſaid by ſome that were abroad, that the Earth ſenſibly roſe up, and ſo ſank down again; but I much queſtion the Truth of it; for if there had been any ſuch Succuſſion to raiſe the Earth to any conſiderable Height, the Houſes would certainly have tumbled down, or the the Exhalation forced its Way by ſome Breach. Nor was our Motion of the Earth that which *Ariſtotle* and *Pliny* call a a Pulſe or an intermittent Knocking, but one continued Shake or Trembling; and therefore muſt be ranked under the firſt Species, *viz.* a Tremor or Shake, without altering the Poſition of the Earth, and left all things in the ſame Poſture in which it found them, except the falling down of the Tops of ſome Chimnies, Stone Walls, &c. without doors; Diſhes and ſome other Things within doors; which I ſhall obſerve when I come to ſpeak of the Degree of the Shake.

That our Earthquake was of the firſt Species is alſo proved from the Sound that accompanied it, ſince tremulous and vibrating Motions are proper to produce Sounds; which brings me to the third

Particular, *viz.* the Noiſe or Sound that accompanied or immediately preceded our Earthquake. This indeed was very terrible and amazing; though I am apt to think it was thought more conſiderable by thoſe within doors, than ſuch as were without in the Air. Some of our People took this Noiſe to be Thunder; others compared it to the Ratling of Coaches and Carts upon Pavements, or frozen Ground. One of my Neighbours liken'd it to the ſhooting out of a Load of Stones from a Cart under his Window. For my own Part, being perfectly awake, though in Bed, I thought at firſt my Servants, who lodged in a Garret over my Chamber, were haling along a Trundle-bed: But, in truth, the Noiſe that accompanies an Earthquake ſeems to be *ſonus ſui generis*, and there is no deſcribing it. This Noiſe, as amazing as it was, in an Inſtant of Time, as one may ſay, was ſucceeded by a Shake much more terrible. My Houſe, which is large and well built, ſeemed to be ſqueezed or preſs'd up together, as though an hundred Screws had been at work to throw it down; and ſhook not only every thing in the Houſe, particularly the Bed under me, but the Building itſelf, and every Part of it ſo violently for the Time, that I was truly in great Fear it would have tumbled down, and my Family periſhed in the Ruin: But through the great Power and Mercy of God, we received no Harm. 'Tis impoſſible to deſcribe the Terror and Amazement that an Earthquake carries with it; and though I had never felt one before, yet I was thoroughly convinced what it was at the very Time.

The next Thing I proceed to is the Degree or Greatneſs of the Shake. This will be beſt known from its Effects. I have already mention'd the falling of the Tops of Chimnies, Diſhes from Shelves, *China* Ware, &c. Doors unlatched, Bells jangling, Beds trembling, Chairs moving, &c. A Country Farmer tells me, he had forty or fifty Rods of Stone Wall thrown down by it: And though I acknowledge theſe Effects are not very conſiderable, yet I cannot but be of opinion, that our Earthquake for its Species was as violent and terrible as any we meet with in Hiſtory: And had the Tremor continued a Minute longer, or been repeated in the like Degree, our Houſes had doubtleſs been many of them overthrown. One of my Neighbours that was walking home at the very Inſtant, tells me, the Noiſe firſt brought him to a ſtand, and that during the Shake, the Earth trembled ſo under him, that he was ſo far from attempting to continue his Walk, that it was as much as he could do to keep upon his Legs, and expected every Moment the Earth would have open'd under him. Another that was riding home, ſays, that upon the Noiſe the Earthquake made, his Horſe ſtood ſtock ſtill, and during the Shake, trembled to that degree, that he thought he would have fell under him. Our Houſe-Dogs were alſo ſenſible and affected with the Earthquake; ſome of them barking, others howling, and making ſtrange and unuſual Noiſes. Nor was our Earth only affected with this Shake, but the Sea alſo in our Harbours, and our Shipping ſmall and great much moved with it. I don't ſuppoſe it ever happens that Earthquakes of this kind, of any Extent, are equal or alike in all Places; and accordingly I find by Information from our ſeveral Towns, that the Shake was much more moderate in ſome Parts of the Country than others.

The Time and Duration of the Shock —— Our *Boſton* News-Papers fix the Time at about forty Minutes after Ten o' Clock at Night: My own Watch was not ſo much by five Minutes; but the Clocks of the Town might be trueſt. The firſt Day of *November* at Midnight, which was three Days after the Earthquake, the Moon changed. As to the Duration of the Shock itſelf —— Whatever others may print or have printed, I can by no means ſuppoſe it exceeded the Space of a Minute, if it was ſo long; I mean the firſt and great Shock; after which in the ſame Night we had four or five more leſſer Tremors; and at ſundry times ſince the Earth has trembled in different Places (even to this 13th of *November*) but without any conſiderable Effects or Extent.

The laſt Thing I have to mention is the Courſe and Extent of the Earthquake. *Boſton*, the Metropolis of this Province, lies in the Latitude of 42 Deg. 25 Min. North, and 4 Ho. 43 Min. to the Weſtward of *London*; as the Longitude between the two Places was ſettled by Mr. *Thomas Brattle* of this Country, and Mr. *Hodgſon* of *London* many Years ſince: And making *Boſton* a Center, we have a certain Account that our late Earthquake was felt in *Kennebeck* River to the Eaſtward, and at *Philadelphia* to the Weſtward, one hundred and fifty Leagues diſtant one from the other upon a W. S. W. and E. N. E. Courſe neareſt: and no Part of the intermediate Country, that I can underſtand, eſcaped the Shake; the Colonies *Rhode-Iſland*, *Connecticut*, and *New-York*, that lie between us and *Penſylvania* being all affected, though not equally, particularly at *Philadelphia* they write, a ſmall Shock. As to the oppoſite Line or Latitude, as we may call it, of the Earthquake, we have two noted Iſlands to the South-Eaſt, called *Nantucket* and *Martha's Vineyard*, about ninety Miles diſtant from *Boſton*, and the firſt named lies about twelve Leagues into the Sea, diſtant from the main Land; both theſe Iſlands had the Earthquake. Our *Engliſh* Settlements towards the North-Weſt, don't yet exceed forty or fifty Miles from *Boſton*; but they all of them had this Earthquake very ſenſibly; and how far it might reach beyond them towards *Canada*, we cannot yet ſay. By this Calculation I believe it will be found, that our Earthquake was of a much greater Extent, than any yet taken notice of in Hiſtory: As to the Courſe of the Earthquake, or where it firſt began, I am not yet able to determine by all the Information I can get: For they write from *Rhode-Iſland*, *Connecticut*, *New-York*, and *Philadelphia*, all to the Weſtward, that it was between the Hours of Ten and Eleven at Night. The ſame again is affirm'd from *Piſcataqua*, *Caſco-Bay*, and *Kennebeck* River, which are to the Eaſtward: So that as yet it ſeems to me, that the Earth, through the whole Extent aforeſaid, was ſhaken very near at the ſame Time. Some of my Neighbours are poſitive, that it came from the Southward; while others again are confident, that where they were, it came from the North. But this is not to be wonder'd at, ſince, as I ſuppoſe, the ſubterraneous Channels or Caverns, through which the Exhalation paſſes, are not in any one continued ſtreight Line, but branched out, and running upon all Points of the Compaſs, eſpecially in ſuch a vaſt Extent of Land.

I am now come to the 28th of *November*, and having met with ſome further Particulars omitted in the preceding Account: I ſhall throw them into a Poſtſcript.

A Neighbour of mine, that has a Well 36 Feet deep, about three Days before the Earthquake, was ſurprized to find his Water, that uſed to be very ſweet and lympid, ſtink to that degree, that they could make no Uſe of it, nor ſcarce bear the Houſe when it was brought in; and thinking ſome Carrion was got into the Well, he ſearched the Bottom, but found it clear and good, though the Colour of the Water was turned wheyiſh or pale. In about ſeven Days after the Earthquake, his Water began to mend, and in three Days more return'd to its former Sweetneſs and Colour. I am alſo very credibly inform'd, that ſeveral Springs and good Watering-Places were ſome of them lower'd, and others quite ſunk and loſt with the Earthquake. A worthy Divine in a Town about twenty Miles diſtant from *Boſton*, aſſures me, that immediately after the Earthquake, there was ſuch a Stink or ſtrong Smell of Sulphur, that the Family could ſcarce bear to be in the Houſe for a conſiderable Time that Night. The like is confirmed alſo from other Places. Perſons of Credit do alſo affirm, that juſt before, or in the Time of the Earthquake, they perceived Flaſhes of Light.

A Gentleman of Probity, from *Newbury*, a Town ſituate between thirty and forty Miles to the N. N. E. of *Boſton*, writes word, that at forty Rods diſtance from his Houſe, there was a Fiſſure of the Earth, and near twenty Cart-Loads of fine Sand thrown out where the Ground brake, and Water boil'd out like a Spring, and mixing with the Sand, made a ſort of Quagmire; but at the Date of his Letter, which was the 21ſt current, the Spring was become dry, and the Ground cloſed up again. Since the Receipt of this Letter, I underſtand, that the Ground where this Sand is thrown up, and round about it for a conſiderable Diſtance, is a ſolid Clay for twenty or thirty Foot deep, and nothing like Sand ever to be found there before; ſo that the Exhalation forced this great Quantity of Sand through a very deep *Stratum* of Clay. I am alſo very well ſatisfied, that the Earthquake was more violent in the Towns to the North and North-Eaſt of *Boſton*, than in thoſe to the Southward and Weſtward; and in ſome of them that are rocky, the Earth ſhook but a few Days ſince.

If any thing further worth communicating ſhould hereafter offer itſelf, I ſhall tranſmit it: In the mean time I hope what I have ſent, will be received by the Society with their uſual Candor and favourable Allowance, from their and your

Very affectionate and humble Servant,

Paul Dudley.

VIII. *An Account of an extraordinary Effect of* Lightning *in communicating* Magnetiſm. *Communicated by* Pierce Dod, *M. D. F. R. S. from Dr.* Cookſon *of* Wakefield *in* Yorkſhire.

A Tradeſman in this Place having put up a great Number of Knives and Forks in a large Box, ſome in Caſes or Sheaths, and others not, of different Sizes, and of different Perſons making, in order to be ſent beyond Sea; and having placed the Box in the Corner of a large Room, there happen'd a ſudden Storm of Thunder, Lightning, *&c.* by which the Corner of the Room was damaged, the Box ſplit, and a good many Knives and Forks melted, the Sheaths being untouch'd. The Owner emptying the Box upon a Counter where ſome Nails lay, the Perſons who took up the Knives, that lay upon the Nails, obſerved that the Knives took up the Nails. Upon this the whole Numbers was try'd, and found to do the ſame, nay, to ſuch a degree as to take up large Nails, Packing-Needles, and other Iron Things of conſiderable Weight. Needles or other Things placed upon a Pewter-Diſh, would follow the Knife or Fork, though held under the Diſh, and would move along as the Knife or Fork was moved; with ſeveral other odd Appearances, which I won't now trouble you with, only this, that though you heat the Knives red-hot, yet their Power is ſtill the ſame when cold.

You may be aſſur'd of the Truth of this, having myſelf made a good many Trials of the Knives and the Forks: How they came by this magnetick Power, or how Lightning ſhould be capable of communicating ſuch a Power, is the *Quære.*

Decem. 6*th*,
1732.

IX. *A further Account of the extraordinary Effects of the ſame* Lightning *at* Wakefield. *By Dr.* Cookſon. *Communicated by the ſame.*

THIS Storm of Thunder and Lightning happen'd the latter End of *July*, 1731. and not only broke the Glaſs and Iron Frames of the Croſs-Chamber Windows, but at the ſame time ſplit ſome Studds in the Corner of a Wood-Houſe; and paſſing into a Room, ſplit likewiſe a large Deal Box, which ſtood in the South Corner of the Room, where the Lightning enter'd, and diſperſed a great many Dozen of Knives and Forks, which were put up in the Box, all over the Room.

Upon gathering up theſe Knives and Forks, ſome of them were melted, others ſnapp'd in ſunder; others had their Hafts burnt; others their Sheaths either ſinged or burnt; others not: But what was moſt remarkable, upon laying them on a Counter where there were Iron Nails, Rings, &c. it was obſerved, that when any of them were taken up, there

hung

hung a Nail or Ring at the End of each of them : moſt of them were try'd, and found to do the ſame ; but little further Notice being taken of them at that Time, they were thrown aſide as damag'd Goods.

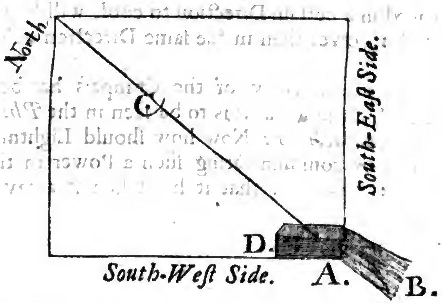
Some Diſcourſe concerning the Effects of Thunder and Lightning happening to be the Subject of Converſion in a Company, where the Owner of theſe Knives was not long ago, he told them what had happen'd at his Houſe, and particularly to the Knives and Forks ; and being ask'd whether he had any of them left, ſaid that he had ; and upon tryal it was found that a good many of them were poſſeſs'd of this magnetick Virtue.

Hearing of this, I went and found what was related, and what I ſent you an Account of before, to be Fact, and have now ſent you a couple of Knives and Forks, one for yourſelf, another for the Royal Society.

The Whittle-Knife, with the Box-Handle, is that which I would have you preſent to the Society ; 'tis an excellent one, and one of the beſt : I had thought to have kept it myſelf ; but if it will be acceptable to that famous Body, it will be much more agreeable to me. They will perceive that it has been uſed pretty much ; and the Owner's Son, who gave it to me, told me, that he has made uſe of it for almoſt a Year and an half to all manner of Purpoſes ; notwithſtanding which it ſtill retains the magnetick Virtue to an extraordinary Degree.

The Situation of the Room, Poſition of the Box and Knives, and Direction of the Lightning, may poſſibly contribute to a fuller Idea of the Matter :

I ſhall therefore preſume to give a Plan of them, an Horizontal one, and ſubmit it and the following *Quæries* to the Conſideration of that Learned Body.



A. The South Angle of the Room where the Lightning enter'd.
B. The Direction of the Lightning.
C. The Polar or Magnetick Line.
D. The Box with the Knives lying in a Direction parallel to the longer Sides of the Box.

Quære, Whether the Knives and Forks lying in ſuch a Direction as either to coincide, or make but an acute Angle with the magnetick Line, might any ways contribute to their imbibing this magnetick Virtue; ſince a Bar of Iron placed in ſuch a Direction, ſhall in a ſmall time receive a tranſient Polarity, and if it continue a long time in that Poſition, a fix'd and permanent one?

Quære, Whether the Knives and Forks lying in ſuch a Poſition, and being violently heated by the Lightning, might not, as they cool'd, ſtrongly imbibe this magnetick Virtue; ſince a Bar of Iron heated and placed in a certain Direction to cool, will ſooner imbibe this Power than in the ſame Direction cold?

Quære, The Polarity of the Compaſs has been alter'd by Lightning, as it is to be ſeen in the *Philoſophical Tranſactions*: Now how ſhould Lightning be capable of communicating ſuch a Power in this Caſe, ſince it is plain that it has taken it away in another?

FINIS.

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MDCCXXXVI.

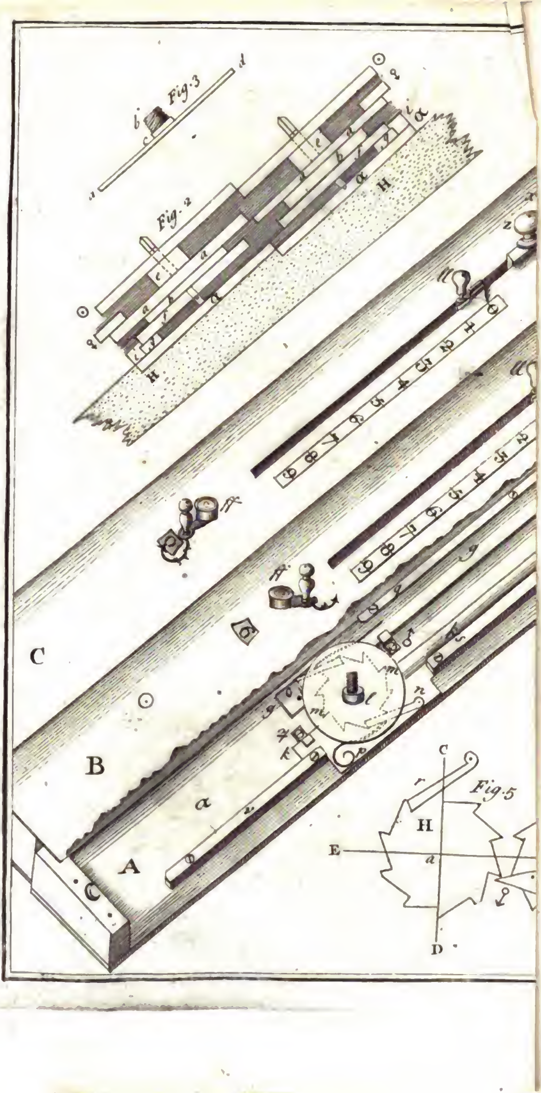
Fig. 3
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Fig. 5
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Numb. 438.

PHILOSOPHICAL TRANSACTIONS

For the Months of *July*, *Auguſt* and *Septem.* 1735.

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V. Halo *obſervatus* Romæ *Anno* MDCCXXXII. *Die* XI. Auguſti *à D.* Did. de Revillas, *Regali Societati communicavit* Tho. Dereham *Bart.*

ERRATA for Philoſophical Tranſactions, N° 437.

PAge 46. line 3. *for* $\overline{R-r}$ *read* $\overline{R+r}$. Line 8. *for* Preſſure *read* Velocity. Lin. 9. *for* $\overline{R-r}$ *read* $\overline{R+r}$, *in both Places*. Lin. 10. *for* $\overline{R-r}$ *read* $\overline{R+r}$.

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MDCCXXXVI.

I. *The* Deſcription *and* Uſe *of an* Arithmetical Machine *invented by* Chriſtian-Ludovicus Gerſten, *F. R. S. Profeſſor of Mathematicks in the Univerſity of* Gieſſen. *Inſcribed to Sir* Hans Sloane, *Bart. Preſident of the* Royal Society. [*See* TAB. *Fig.* 1, 2, 3, 4, 5.]

SIR,

BEING at preſent on the Point of returning Home, I think myſelf obliged before my Departure, to return my humble Thanks to that Learned Body the *Royal Society*, over which you preſide, for the Honour they have lately done me, in chuſing me a Member; and to make a grateful Acknowledgment to you in particular, for the many Favours and Civilities, which, according to that amiable Character of Benevolence to all Strangers in general, you have been pleaſed to beſtow on me.

It is now a Duty incumbent on me to communicate to the *Royal Society* from time to time any thing new and curious, which may fall in my way: Therefore I now lay before them a Draught and Deſcription of an *Arithmetical Machine*, which I invented about twelve or thirteen Years ago.

Sir *Samuel Morland* was, for ought I know, the firſt who undertook to perform Arithmetical Operations by Wheel-work. To this end he invented two different Machines, one for *Addition* and *Subſtraction*, the other for *Multiplication*, which he publiſhed in *London*, in the Year 1673, in *ſmall*

Twelves.

Twelves. He gives no more than the outward Figure of the Machines, and ſhews the Method of working them. But as by this every one, who has any Skill in Mechanicks, will be able to gueſs, how the inward Parts ought to be contrived; ſo it cannot be denied, that theſe are two different Machines, independent of one another; that the laſt, which is for *Multiplication*, is nothing elſe but an Application of the *Neipperian* Bones on flat moveable Disks; conſequently that his Invention alone is not fit to perform juſtly all Arithmetical Operations.

After him the celebrated Baron *de Leibnitz*, the Marcheſe *Poleni*, and Mr. *Leupold* took this Undertaking in hand, and attempted to perform it after different Methods.

The firſt publiſhed his Scheme in the Year 1709, in the *Miſcellanea Berolinenſia*, but then he gave only the outward Figure of the Machine. Signor *Poleni* communicated his, but explaining at the ſame time its inward Conſtruction, in his *Miſcellanea* of the ſame Year, 1709. Mr. *Leupold*'s Machine, together with thoſe of Mr. *de Leibnitz* and Signor *Poleni*, were inſerted in his *Theatrum Arithmetico-Geometricum*, publiſhed at *Leipzig* in 1727, after the Author's Death, yet imperfect, as it is owned in the Book itſelf.

Beſides theſe, I learned from ſeveral *French* Journals, that *Charles Paſcal* invented one, which however I never had the ſight of.*

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* The Deſcription of this Machine is ſince printed by *M. Gallon* in his Collection of Machines and Inventions approved by the *Academy of Sciences* at *Paris* (publiſhed in *French* at *Paris*, 1735. in *Quarto*, in Six *Tomes*) in *Tom.* IV. *p.* 137; and likewiſe another by M. *Leſpine*, *Tom.* IV. *p.* 131; and three more by M. *Hellerin de Boiſtiſſandeau*, *Tom.* V. *p.* 103, 117, & 121.

I took the Hint of mine from that of Mr. *de Leibnitz*, which put me upon thinking how the inward Structure might be contrived: But as it was not poſſible for me to hit upon the original Ideas of that Great Man, an exact Enquiry into the Nature of Arithmetical Operations furniſhed me at laſt with others, which I expreſſed in a rough Model of Wood, and ſhewed to ſome Patrons and Friends, who encouraged me to have another made of Braſs: But the want of an Artificer, able enough to execute my Ideas, made me delay it till the Year 1725; when having ſpare Time, and finding an Inclination to divert myſelf with Mechanical Operations, I ſet about it, and finiſhed the whole Work, fitted to a Reckoning not exceeding ſeven Places. And in *December* of the ſame Year, I had the Honour to lay this Machine before my Sovereign, the preſent Landgrave of *Heſſen Darmſtadt*, and the Hereditary Prince his Son, to whom I demonſtrated the Mechaniſm of the whole Invention.

I own that the gracious Reception it met with from both their Highneſſes, as well as the expreſs Recommendation of Mr. *de Wieger*, one of the Prince's Privy-Council, would have been powerful Inducements for me to have publiſh'd at that time an Account of my Machine; but I was checked by the Uncertainty I was under, whether poſſibly Mr. *Leibnitz*'s Machine had not been brought to its Perfection; in which caſe there is no doubt but the Operation of his Machine, if it would really perform what is promiſed in the Deſcription, would have been eaſier than mine, and conſequently preferable to it, provided its Structure did not prove too intricate, nor that the working of it took up too much time.

But at preſent, being certain that none of Mr. *Leibnitz*'s Invention has yet appeared in ſuch a State of Perfection, as to have anſwer'd the Effect propoſed, and that theſe of mine differ from all thoſe mentioned above, fancying at the ſame time, that Perſons who underſtand Mechanicks, will find it plain, practicable, and exact, in regard to its various Effects, I make no Scruple to preſent to the *Royal Society* this Invention, the Product of my younger Years indeed, but now with the ſeveral Amendments I have ſince added to it, as a Mark of the Reſpect and Veneration I have for this illuſtrious Body.

The Particulars of it are as follows:

There are as many Sets of Wheels and moveable Rulers as there are Places in the Numbers to be calculated. *Fig.* 1. ſhews three of them, by which one may eaſily conceive the reſt. A A ſhews the firſt Syſtem or the Figures of Unites, according to its inward Structure. B B and C C ſhews the ſecond and third Syſtem, *viz.* of Tens and Hundreds, according to their outward Form. We ſhall firſt conſider A A; where *α α α* is a flat Bottom of a Braſs Plate, which may be skrewed on either upon a particular Iron Frame, or only upon a ſtrong Piece of Walnut-Tree, doubled with the Grain croſs'd. In this Syſtem are two moveable Rules *gggg*, and *kkk*, the firſt of which I call the Operator, the ſecond the Determinator. There are beſides two Wheel-Works, the upper one is for *Addition* and *Subſtraction*, the lower one ſerves for *Multiplication* and *Diviſion.* The upper one is provided firſt with *a*, an oblique Ratchet-Wheel of 10 Teeth, of what Diameter you pleaſe, on which, however, depends the Length and Breadth of the Syſtem itſelf. This Wheel has a Stop *r*, with a depreſſing Spring *t*; Under the Wheel *a* is a ſmaller Wheel *b* of the ſame Shape: Both *a* and *b* are rivetted together, and fixed on a common Axis. Under the Wheel *b* lies a third *f*, which is a common Tooth-Wheel of 20 or more Teeth, according as one pleaſes: It is larger than *b*, and ſmaller than *a*, turns about the ſame Axis with the other two above it, and upon it is fixed a Stop *c*, with the Spring *d*, which catches the oblique Teeth of the Wheel *b*. Immediately under this Wheel lies the upper Part of the Operator, which may be beſt made of Iron or Steel. The Wheels may all be of Braſs, except the upper one. The Operator is of the ſame Thickneſs all over, and in its upper Part are fixed as many round Steel Pins as there are Teeth in the Wheel *f*, which are to catch the Teeth of this Wheel, and move it backwards and forwards. The Height of thoſe Pins ought exactly to anſwer the Thickneſs of the Wheel *f*. The Axis of the Wheels *a* and *b* is kept perpendicularly by the Bridge *ee*, which is ſkrewed to the Bottom, as appears by the Figure. The Operator *gggg* moves on the Side, above, and in the Middle in two Braſs Grooves *iii* and *qq*; about D it jets out, on which Projection a Piece of Iron *h* muſt be well faſtened, having a ſtrong Pin, on which the Handle *z* fits, as you ſee in the Syſtem B B. The Side D itſelf ſlides in another Groove *ss*, and in its inner Corner joins to it the Determinator *kkk*, of the ſame Thickneſs with the Operator, the Shape of which is ſufficiently expreſſed in the Figure. This ſlides alſo up and down, on the one Side in the Groove *s s*, and *v* on the other Side, where it is ſmalleſt, in a ſmall Piece of Braſs *u*, and where it is broadeſt, above in the Operator itſelf, which is either hollowed out into another Groove, or filed off obliquely. The ſliding Part of the Determinator ought afterwards alſo to be fitted to it. Its chief Part is the Lock *u*, ſtanding perpendicular on its broad Part. I have drawn it ſeparately in *Fig.* 4. B B, in which the ſliding Stop *c*, which is preſſed down by its Spring *d*, but raiſed by the Tricker *a a*. That Tricker has a Pin *b*, on which is ſkrewed on the ſmall Handle *l l* (*Fig.* 1. in the Syſtems BB and CC.) In the Braſs Bottom A A (or *α α* *Fig.* 1.) you muſt file out 10 Ratchet-Teeth or Kerfs, purpoſely for the Stop of this Lock, or, which is better, you may inſert into the Braſs Bottom a ſmall Piece of Iron filed out according to this Figure. The Partition and Length of theſe Rachet-Teeth in the Bottom muſt fit exactly with the Circumference of the Wheel *f*, (*Fig.* 1. *Syſtem* A A,) with this Direction, that if the Lock is kept by the uppermoſt Tooth in the Bottom, the Operator cannot be moved at all; but when by preſſing down the Tricker *a a*, (*Fig.* 4) the Determinator is ſhoved down, and is ſtopp'd by the ſecond or third Tooth in the Bottom, the Operator being alſo drawn down as far as the Determinator permits, makes the Stop *c* (*Fig.* 1. *Syſt.* A A) ſlide over 1 or 2 Teeth of the ſecond Wheel *b*; conſequently the ſame Stop *c*, muſt ſlide over 9 Teeth, when the Lock of the Determinator will ſtand before the 10th Tooth in the Bottom, and the Operator is pulled down ſo far. If you have a mind to apply theſe Rachet-Teeth on the Outſide of the Plate ⊙ ⊙, that covers the Whole, you may fit the Lock to it accordingly: But in this Caſe the Covering-Plate muſt be well faſtened.

For *Multiplication* and *Diviſion*, there is properly in each Syſtem but one Wheel, likewiſe divided into 10 Rachet-Teeth, on which is rivetted the round Plate *l*, on which are engraved the Numbers or Figures: Theſe Wheels have no occaſion for any Bridge, but may turn about a ſtrong Pin of Steel, ſolder'd to the Bottom. The Rachet-Wheel *m m* reſts on one Side upon the Determinator, and upon a Piece of Braſs of the ſame Thickneſs, to which are faſtened the Stop *n*, and the Spring *p*. Upon the Operator is another Stop *o*, with its Spring; which Stop has a ſmall Arm at *o*, which is checked by a ſmall Studd, to hinder the Spring's preſſing the Stop lower down than it ought: By which Contrivance it is ſo order'd, that after the Operator is ſlid down ſo far as it can go, in being ſlid up again, the Stop *o* will turn but one Tooth of the Wheel *m m*. The round Plate *l* has in its Middle a ſmall hollow Axis, on which are turned firſt two Shoulders, and then a Skrew: This Skrew in the Syſtem A A is an ordinary one, winding from the left to the right.

But as each Syſtem ought to have Communication with the preceding one, though not with that which follows; to this end a projecting Tooth of Communication made of Steel ℘ is rivetted to the upper Plane of the uppermoſt Wheel *a*. This Tooth muſt be placed exactly on the Point of a Tooth of the Wheel, and by its Revolution catches and turns every time but one Tooth of the uppermoſt Wheel of the preceding Syſtem, ſliding over the following one (if there be any) without touching it. For this reaſon the Planes of the Braſs Bottoms in all the Syſtems ought to incline a little. This will beſt appear from the Vertical Section, *Fig.* 2. (cut in *Fig.* 1. in the Direction from ♄ to *f*) in which *α* is the Braſs-Bottom, HH the Wood-Bottom, *g* the Operator, *i* the Groove, *f* the third common Tooth-Wheel, *b* the ſecond Wheel, *a* the firſt or uppermoſt Ratchet-Wheel, *e* the Bridge, ⊙ the Covering-Plate, and ℘ the Tooth of Communication. I have repreſented all theſe Pieces of one Thickneſs ; but every Artiſt will eaſily know where to add or take off.

Fig. 5. ſhews the Plan and true Diſpoſition of the Teeth in the ſeveral uppermoſt Wheels ; that is to ſay, The Parallel Lines AB and CD ought always to cut the Braſs Bottoms (which are like one another in Length and Breadth) length-wiſe into two equal Parts : Then the perpendicular Interſection EF will determine the Centers *a* and *b*, of the two Wheels H and G. The Stop *r* ought every time to hold its Wheel in ſuch a manner, that the Points of two Teeth coincide with the Line AB or CD. The Obliquity of the Teeth is the ſame in both, with this difference however, that in G, which is a Wheel of the Syſtem AA, (*Fig.* 1.) they are cut in from the left to the right, but in H (a Wheel of the Syſtem BB) from right to the left. I need not take notice, that for making the Work more durable, the Teeth are not to be cut out into quite ſharp Points, but blunted a little, as in the Wheel H. The Nicety of the whole Machine chiefly conſiſts in placing the Center *a* and *b*, or (which amounts to the ſame thing) after having choſen the Breadth of the Braſs-Bottoms, in determining the Diameter of the uppermoſt Wheel: For if that ſhould prove ſo large, as that the two Wheels H and G ſhould very near touch one another, the Tooth of Communication will be ſhort, its Operation will be of a ſmall Force, and the Wheels themſelves will require a very great Exactneſs, leſt by turning about the Wheel H, and the Tooth of Communication ſtanding in the Poſition as it is repreſented in *Fig.* 5, a Tooth of the Wheel H may touch it, and ſtop the Motion. Whereas,on the other hand,ſuppoſing the Centers at the ſame Diſtance, and the Diameters of both Wheels leſs, the Tooth of Communication will be longer: then ſuch an Exactneſs is not requir'd in the Wheel, yet more Force is neceſſary for making the Tooth of Communication lay hold the better. Furthermore, it will be well for you to make the undermoſt common Tooth-Wheel as large as you can.

From the Conſtruction of this firſt Syſtem, with which the 3d, 5th, 7th, &c. entirely agree, one may eaſily imagine the 2d, 4th, 6th, 8th, *&c.* for every thing there alſo is the ſame, except only, that it is inverted; ſo that what in the firſt ſtands on the Right-hand, is on the Left in the ſecond.

The Plate for *Multiplication* has on its hollow Axis, as it is ſaid before, two Shoulders, the lowermoſt of which is very ſmall, the Sum of its Height, the Thickneſs of the Plate of the Wheel *m m*, and of the Operator muſt amount to as much as anſwers to the Heighth of the Bridge *ee*. On both Ends of the Braſs-Bottoms, the two Piece of Braſs ☾ ☾, of the ſame Height, are rivetted on. This being done, at laſt the Covering-Plates ⊙⊙ is prepared and ſkrewed on the Piece of Braſs ☾ ☾. If the Machine be made pretty large, the Covering-Plate muſt be ſkrewed faſt, not only to the Bridge *ee*, but alſo not far from the Wheel of Multiplication. It muſt be provided not only with round Holes, through which are to go the Axis of each uppermoſt Wheel *a*, and the hollow Axis of the Plate *l*; but it muſt alſo have a long Slit, in which the Operator and Determinator may be moved up and down, and laſt of all a ſmall Window over the Plate of *Multiplication*, through which the Figure or Number engraved on the Plate may appear diſtinctly. To the projecting Skrew *l*, of the Plate *l*, is fitted an Handle *ff*, joined to an Index in the Shape of a Scythe. The Skrew in the Syſtem A A is a common Skrew, conſequently the Roundneſs of the Scythe muſt turn from the left to the right; but in the Syſtem BB, where it ought to be inverted, like all the other Parts, the Scythe muſt turn from the right to the left, as in the Figure. The Uſe of this is to ſhew which Way the Wheels are to be turned; and the Skrews are to prevent the Machine's being hurt by unſkilful Hands.

On the Side of the Determinator, *viz.* on that Piece which cannot be preſſed down, is alſo ſkrewed a ſmall Index, which may be directed to ſuch Numbers or Figures as is required. Theſe Figures are to be engraved in the Covering-Plate, according to the Figure, and their Diſtance depends on the Ratchet-Teeth *e e* (*Fig.* 4.) in the Braſs-Bottom.

On the Axis of each uppermoſt Wheel *a* (which Axis muſt be made ſquare as far as it projects over the Covering-Plate) is fixed a thin round Silver-Plate *x x* (in the Syſtems BB and CC) or *a d* in *Fig.* 3. yet ſo that it may not rub againſt the Covering-Plate. It has a hollow Axis *bc* (*Fig.* 3.) on which is a right or left Skrew, according to the Syſtem it belongs to, and a ſmall Shoulder *c*. To the Skrew is skrewed the Handle *ſs* (Syſtem BB and CC, *Fig.* 1.) which is vertically flat on the Extremity, in order to turn by it the Plate and the Wheels. The Plate (as appears by the Figure) is divided by 3 concentrick Circles into two Rings, in the outmoſt of which are engraved the Numbers for *Addition*, in the inmoſt thoſe for *Subſtraction.* I will hereafter call this Plate only the *Silver-Plate*, the firſt Ring the *Addition-Ring*, the ſecond the *Subſtraction-Ring :* Moreover two Indexes *w* and *y* are skrewed to the Covering-Plate; *w* ſhews the Numbers of the outmoſt or *Addition-Ring*, and *y* thoſe of the *Subſtraction-Ring*. They have Hinges, that they may be lifted up, and the *Silver-Plate* taken out or put in again : Their Curvature ſerves for a Direction, which way the Plates ought to be turned. A skilful Artificer will be able to give them a neater and handſomer Shape, than here in the Draught, where I would not cover the Numbers.

All this being done, there remains now the Figures or Numbers to be engraved, in the manner following : Place each uppermoſt Wheel *a* (Syſtem AA) ſo, that the Tooth of Communication be ready to catch (as in G, *Fig.* 5) which may be eaſily felt. Obſerve in the Silver-Plate, where the Index *w* points, and there engrave the Number or Figure 9, lower down in the *Subſtraction-Ring*, where the Index *y* points, engrave the Cypher *o*. After this divide both Rings into 10 equal Parts, one of which is already deſigned for 9 in the *Addition*, and another for *o* in the *Subſtraction-Ring*; then obſerve which way the Wheel turns, if from the right to the left, as in Syſtem BB; then you muſt from the engraved Number 9 in the *Addition-Ring*, towards the right engrave *o* next, then 1, 2, 3, 4, *&c.* and in the *Subſtraction-Ring* towards the right alſo, from the already engraved *o*, firſt engrave 9, then 8, 7, 6, *&c.* *ordine inverſo*. But if the Wheel turns from the left to the right, as in the Syſtems AA and CC, you engrave the Numbers or Figures in the ſame Order, but from the right to the left (See in *Fig.* 1. the *Syſtems* BB and CC.)

In the *Multiplication-Wheels mm* you muſt conduct the Index *ff* exactly to the Window, as it is drawn in the Syſtem BB; mark the Place on the round *Multiplication-Plate* under the Window, and engrave upon it the Cypher or *o*: Then make, by two concentrick Circles, a Ring upon this Plate, and divide this Ring into ten equal Parts, and after the *o* (already engraved) engrave on the Numbers 1, 2, 3, 4, 5, 6, 7, 8, 9, in the ſame Order as it was done in the *Addition-Ring* of the Silver-Plate of the ſame Syſtem. Laſt of all, if you think fit, you may ſkrew on thin Ivory Plates, to note upon them the Numbers which are to be calculated, particularly a long ſmall one on that Side of the Slit of the Determinator, where there are no Numbers, and alſo two ſhorter broader ones, one under the Window of *Multiplication*, the other above the Silver-Plate. All this together compoſes a Machine, by the help of which you may perform all the four Arithmetical Rules or Operations. The Way of working it, is as follows:

I. *As to Addition:* For inſtance, if you are to add 32 and 59; becauſe the hindmoſt Syſtem A A in the Figure, which ought to repreſent the Place of Unites, is not cover'd, let us take the Syſtem B B for the Place of the Unites, and the Syſtem C C for the Place of the Tens; turn the Silver-Plates *x x* in theſe two Syſtems, that the Indexes *w w* point to the two Numbers 5 and 9; then make the Determinators *ll*, *ll*, point alſo to 3 and 2: next take one of the two Operators, *ex. gr.* in B B, and pull it down as far as you can, and move it upwards again. This done, the Number 1 of the Silver-Plate in B B will come by this means under the Index *w*, and the Number 6 of the Silver-Plate in the Syſtem C C under its Index at the ſame time, which is 61, the Sum, 59 and 2. After this move the Operator of the Syſtem C C alſo up and down, when inſtead of 6, 9 will come under the Index; conſequently you have 91 under the Indexes *w w*, which is the Sum requir'd of 59 and 32 added together. The Reaſon of it is plain; for by pulling down the Operator of the Syſtem B B ſo far, the Stop *c* of the lowermoſt or common Tooth-Wheel *f* (*vid.* Syſt. A A) will ſlide over two Teeth of the Ratchet-middlemoſt Wheel *b*; and by moving the Operator up again, the ſame Stop *c* will turn the two Ratchet-Wheels *a* and *b* together, and cauſe the Stop *r* of the great or uppermoſt Wheel *a* to ſlide alſo over two Teeth ; at the ſame time the Tooth of Communication *e* will move forward one Tooth of the uppermoſt Ratchet-Wheel in the Syſtem CC ; conſequently on the Silver-Plate in BB, inſtead of 9 the Number 1, and in Syſtem CC, inſtead of 5 the Number 6 muſt appear under their Indexes *ww* ; and ſo for the ſame reaſon, having pulled up and down the Operator of the Syſtem CC, the Number 6 pointed to by the Index muſt be at laſt changed into 9.

II. *Subſtraction.* Suppoſe 40 the Sum, from which you are to ſubſtract 24 : Here you muſt put your Sum 40 in the *Subſtraction-Rings* ; that is to ſay, turn the Cypher *o* in the Syſtem BB, and the Number 4 in the Syſtem CC, under the Indexes *yy*, as the Figure ſhews : Set the Determinators at 24, as in *Addition* ; move alſo the Operators only once up and down, the Remainder 16 will appear under the Indexes *yy*. As for the Reaſon of this Operation, when you conſider, that the Numbers in the *Subſtraction-Rings* are engraved *inverſo ordine*, as it is ſaid before, you will find that it is the ſame as in *Addition*.

III. *Multiplication.* For inſtance ; if you are to multiply 43 by 3, bring the *o* in all your *Addition-Rings* to the Indexes, as alſo in all your *Multiplication-Plates* in the Windows. Write down (which is more particularly neceſſary if the Numbers are larger than here) the Multiplicand 43 upon the Ivory-Plates near the two Determinators in the two Syſtems BB and CC : But the Multiplicator 3, you may write only on the Ivory-Plate under the

Window of the Syſtem BB. Set the Determinators at 43 ; then move your Operators ſucceſſively as often up and down, till there appears in both Windows the Number 3 ; then you will ſee on your *Addition-Rings* under the Indexes, the Product 129.

It is eaſy to underſtand, that as the *Multiplication* is nothing elſe than a repeated *Addition*, the Machine does alſo perform its Operation by a repeated *Addition* only : For the Number 3, which appears in the Window of the Syſtem B B, ſhews how many times you have added the Number 3, pointed by the Determinator to itſelf, which when done 3 times, is 9. And ſo the ſame Number 3, which appears in the Window of the Syſtem C C, after your Operation, ſhews how many times you have added the Number 4 to itſelf. I need not to make you obſerve, that beſides the two Syſtems B B and C C, there muſt be ſuppoſed another, not expreſs'd in the Figure, which will ſhew the Number 1 of the Product 129.

IV. *Diviſion.* If you are, for inſtance, to divide 40 by 3, ſet your Dividend 40 in the *Subſtraction-Rings* under the Indexes *y y*, in the Syſtem B B and C C ; turn the Indexes *ff*, *ff*, near the Windows to make *o* appear ; write your Diviſor near the Determinator of the Syſtem C C, and ſet the Determinator at 3 ; pull the Operator up and down, then you will have 1 under the Index *y*, and 1 likewiſe in the Window. By this you ſee, that you cannot work further in this Syſtem C C, becauſe you cannot ſubſtract 3 from 1 : You muſt therefore go on, to the other Figure of the Dividend, *viz.* 0, and in the Syſtem B B ſet the Determinator again at 3.

This being done, the firſt pulling of the Operator up and down will produce 1 in the Window, and 7 in the *Subſtraction-Ring* under the Index, and the Number 1 which remained before in the Syſtem C C will be changed into *o*. Now as 7 is more than 3, you muſt work on accordingly ; having done it twice more, you will find that there remains under the Index *y* but 1, (which is the Numerator of your Fraction) and below in the two Windows the Quotient 13. When you conſider that *Diviſion* is nothing elſe but a repeated *Subſtraction*, you will alſo eaſily underſtand the reaſon of this Operation.

Thoſe that underſtand the matter ever ſo little, may now eaſily conceive how they are to proceed with this Machine in larger *Examples* : However, for greater Clearneſs, I will explain it by two *Examples*.

	f	*e*	*d*	*c*	*b*	*a*	
A	0	0	0	0	0	0	B
C			3	5	6	3	D
E	0	0	0	0	0	0	F
					5	8	

Suppoſing there are ſix Syſtems, *a*, *b*, *c*, *d*, *e*, *f*; Let all the Numbers pointed to by the Indexes *ww* be in A B ; thoſe which are to be pointed to by the Determinators, in C D ; and thoſe which are ſeen in the Windows, in E F. Firſt of all, you muſt turn all your *Addition-Rings* of the *Silver-Plates* and your *Multiplication-Plates* to *o* ; *viz.* that under all the Indexes *w w*, and in the Windows nothing may appear but *o*. Write the Number 3563 near the Determinator, in the Syſtems *a*, *b*, *c*, *d*, and direct them accordingly : The other Number 58, you muſt write down likewiſe, but under the Windows in Syſtem *a* and *b*, as you ſee in this

Scheme. Move the ſeveral Operators, which are moveable, ſucceſſively as often up and down, till 8 appears below in the Windows, and you will have under the Indexes above 28504, the Product of 3563 × 8. And ſo the Numbers of the Machine will appear thus.

	f	*e*	*d*	*c*	*b*	*a*	
A	0	2	8	5	0	4	B
C			3	5	6	3	D
E	0	0	8	8	8	8	F
					5	8	

Next advance your Multiplicand 3563, from the Right to the Left; that is to ſay, place the Determinator in the Syſtem *b* at 3, in *c* at 6, in *d* at 5, in *e* at 3, and reduce every Number in the Windows to 0, except in the Syſtem *a*. See the *Scheme* following.

	f	*e*	*d*	*c*	*b*	*a*	
A	0	2	8	5	0	4	B
C		3	5	6	3		D
E	0	0	0	0	0	8	F
					5	8	

Then pull all the Operators again ſucceſſively in *b*, *c*, *d*, and *e*, up and down, till 5 appears in the Windows below, and you will find at laſt under the Indexes 206654, the Product of 3563 × 58.

	f	*e*	*d*	*c*	*b*	*a*	
A	2	0	6	6	5	4	B
C		3	5	6	3		D
E		5	5	5	5	8	F
					5	8	

But if you are to divide again 206654 by 3563, you muſt place the Dividend above in the *Subſtraction-Rings* under the Indexes. In the Windows below, every Figure muſt be 0, likewiſe as in the *Multiplication*; and write the Diviſor under the Dividend, according to *Vulgar Arithmetick*, and as in the *Figure* here annexed.

	f	*e*	*d*	*c*	*b*	*a*	
A	2	0	6	6	5	4	B
C		3	5	6	3		D
E	0	0	0	0	0	0	F

If you direct the Determinators in *e*, *d*, *c*, *b*, to their Numbers, and ſubſtract this Diviſor by pulling up and down the Operators as often as you can, you will have in the Windows in *e*, *d*, *c*, *b*, every where 5; but on the *Silver-Plates* there will remain 28504. Now advancing your Diviſor from the Left to the Right, bringing to the Windows in *d*, *c*, *b*, all the Cyphers 0, and operating as before, there will at laſt appear on the *Silver-Plates* nothing at all, but below in the Windows 5888. See the *Figure* following:

	f	*e*	*d*	*c*	*b*	*a*	
A	0	0	0	0	0	0	B
C			3	5	6	5	D
E		5	8	8	8	8	F

And here you have only this to obſerve, that in ſuch Caſes, you cut off all the hindermoſt Figures or Numbers in E F, except that which ſtands under the firſt Figure of the Diviſor; what remains is your Quotient.

As for what remains, if it be objected that this Machine cannot be fitted for ſo many and long

Numbers, as one would pleaſe, becauſe the Multiplication of ſo many Syſtems would require too great a Force for one Operator to move ſo many Wheels, kept by Springs, ſuppoſing the caſe that all the Teeth of Communication ſhould duly catch; I own that this Objection is but too well grounded: However, I cannot help obſerving at the ſame time, that this Defect can hardly be avoided, in any Arithmetical Machine, for performing all thoſe Operations of itſelf, without the help of the Mind: For there muſt certainly be a particular Syſtem for each Place of Figures, which is to communicate with the next; conſequenly, as the Syſtems encreaſe in Number, the Force muſt encreaſe alſo which is requir'd for moving them all. Beſides, it ought to be conſider'd, of what Size ſuch a Machine ought to be, which might ſerve for common Uſe. I think few Calculations could be required, for which 14 or 16 Syſtems might not ſuffice. That which I made was of 7 Syſtems, as I have already mention'd. The Diſpoſition of it was neither ſo well contrived as I have explained it here, nor were its ſeveral Parts ſo well wrought, as a good Artificer, who makes Profeſſion of ſuch Work, might have performed it; yet thoſe 7 Syſtems were very eaſily put in Motion; and if in a Machine for 14 Figures made by a ſkilful Hand, it could not be ſo eaſily practicable, this Defect, I believe, might be eaſily remedied, by applying the other Hand in the fifth or ſixth Syſtem to the Handle *fs*, in order to eaſe and aſſiſt the Operator.

I am your humble Servant,

C. L. GERSTEN.

II. *Of the* Figure of the Earth, *and the* Variation of Gravity on the Surface. *By Mr.* James Stirling, *F. R. S.* [*See* TAB. *Fig.* 6.]

THE Centrifugal Force, ariſing from the Diurnal Rotation of the Earth, depreſſeth it at the Poles, and renders it protuberant at the Equator; as has been lately advanced by Sir *Iſaac Newton*, and long ago by *Polybius*, according to *Strabo* in the Second Book of his *Geography*. But although it be of an oblate ſpheriodical Shape, yet the kind of that Spheroid is not yet diſcovered; and therefore I ſhall ſuppoſe it to be the common Spheroid generated by the Rotation of an Ellipſis about its leſſer Axis; although I find by Computation, that it is only nearly, and not accurately ſuch. I ſhall alſo ſuppoſe the Denſity to be every where the ſame, from the Center to the Surface, and the mutual Gravitation of the Particles towards one another to decreaſe in the duplicate Ratio of their Diſtances: And then the following Rules will follow from the nature of the Spheroid.

1. Let ADBE be the Meridian of an oblate Spheroid, DE the Axis, AB the Diameter of the Equator, and C the Center. Take any Point on the Surface, as F, from which draw FC to the Center, FG, perpendicular to the Surface at F, meeting CB in G, and FH cutting the Line CG, ſo that CH may be to GH as three to two. I ſay that a Body at F will gravitate in the Direction FH;

and that the mean Force of Gravity on the Surface will be to the Exceſs of the Gravity at the Pole above that at F, as the mean Diameter multiplied into the Square of the Radius is to one fifth of the Difference of the longeſt and ſhorteſt Diameters multiplied into the Square of the Co-ſine of Latitude at F.

2. The Decrement of Gravity from the Pole to the Equator is proportional to the Square of the Co-ſine of Latitude; or, which comes to the ſame, the Increment of Gravity from the Equator to the Pole is proportional to the Sine of Latitude. Hitherto I have conſider'd the Variation of Gravity which ariſes from the ſpheroidical Figure, while it does not turn round its Axis; but if it doth, the Direction of Gravity will be in the Line F G, perpendicular to the Surface; and its Variation now ariſing from both the Figure and centrifugal Force, will be five times greater than what ariſes from the Figure alone; as will appear from the Proportion of the Lines F H and F G, the former being to the latter, as the whole Force of Gravity at F, while the Speroid is at reſt, to the Force with which a Body deſcends at F, while it turns round its Axis.

3. From this laſt Article it appears, that one fifth of the Variation of Gravity is occaſion'd by the Figure of the Spheroid, and the remaining four fifths by the centrifugal Force. And whereas the Earth could not be of an oblate ſpheroidical Figure, unleſs it turned round its Axis; nor could it turn round its Axis, without putting on that Figure: I ſay, that the Diminution of Gravity towards the Equator, known by the Experiments with Pendulums,

lums, prove both the Rotation and oblate ſpheroidical Figure of the Earth.

4. The mean Force of Gravity on the Surface is to the centrifugal Force at any Point F, as a Rectangle under the Radius and mean Diameter to a Rectangle under the Co-ſine of Latitude, and four fifths of the Difference of the longeſt and ſhorteſt Diameters. And at the Equator, where the Co-ſine of Latitude becomes equal to the Radius, the mean Force of Gravity is to the centrifugal Force, as the mean Diameter to four fifths of the longeſt and ſhorteſt Diameters. This Article is found from the Proportion of the Lines F H and G H; the former being to the latter as the Force of Gravity to the centrifugal Force.

5. The Proportion of the Diameters of the Earth will be found in the following manner: The Moon revolves about the Earth in 27^d, 7^h, $43'$, or in 39343 Minutes: And her mean Diſtance is about $59\frac{1}{2}$ Semidiameters of the Earth, according to *La Hire*'s and *Flamſtead*'s Tables; but near $60\frac{1}{2}$ by *Halley*'s Tables. I ſhall therefore take 60 for the mean Diſtance, till it be better known: Then according to the Nature of Gravity, as the Cube of the Moon's Diſtance to the Semidiameter of the Earth, or as 216000 to Unity, ſo is 1547870000 the Square of the periodick Time of the Moon to 7166, the Square of the Number of Minutes in which another Moon would revolve about the Earth at the Diſtance of its Semidiameter. And as this laſt Number to 2062096, the Square of 1436, the Number of Minutes in a Sydereal Day, ſo is Unity to 287.7; which would ſhew the Proportion of the

centrifugal Force at the Equator to the mean Force of Gravity (by *Corol.* 2. *Prop.* 4. *Lib.* 1. *Princip.*) were it not for the Action of the Sun on the Moon. Therefore (by *Corol.* 17. *Prop.* 66. *Lib.* 1. *Princip.*) I ſay, as the Square of the Sydereal Year, to the Square of the periodick Time of the Moon, that is, as 179 to Unity, ſo is 287.7 to 1.6; which being added to 287.7, makes 289.3. And therefore, as Unity to 289, neglecting the Fraction which is uncertain; ſo is the centrifugal Force at the Equator to the mean Force of Gravity on the Surface. And thence (by Article 4.) as 289 to $\frac{5}{4}$, ſo is the mean Diameter to the Difference of the longeſt and ſhorteſt: And therefore, as the Axis is to the equatoreal Diameter, ſo is 2307 to 2317, or in ſmaller Numbers, as 231 to 232, the ſame as Sir *Iſaac Newton* found in a different manner; for he makes it as 230 to 231, and as 230 to 231, ſo is 231 to 232.004.

6. In the ſame manner the Proportion of the Diameters of any Planet may be found, if it has a Satellite: For Inſtance, in *Jupiter*, he turns about his Axis in 9^h, 56′, or in 596 Minutes: And his third Satellite revolves about him in 7^d, 3^h, 42′, 36″, or in 10302.6 Minutes, at the diſtance of 15.141 of his Semidiameters. Therefore, I ſay, as the Cube of 15.141 to Unity, ſo is the Square of 10302.6 to 30579, the Square of the Number of Minutes in which a Satellite would revolve about him at the diſtance of his Semidiameter: And as this laſt Number is to 355216, the Square of 596, ſo is Unity to $11\frac{5}{8}$, or the centrifugal Force at his Equator to the mean Force of Gravity on his Surface. There is no need of correcting this Number,

as in the former Article, becauſe the periodick Time of *Jupiter* round the Sun is vaſtly greater than that of his third Satellite round him. I have choſe the third Satellite before any of the reſt, becauſe its greateſt Elongation was obſerv'd by Dr. *Pound*, with a Micrometer adapted to a Teleſcope 123 Feet long; and he alſo took the Diameter of *Jupiter* by the Tranſit of the Satellite, which is a much more exact Way than with a Micrometer. But as the Planes of *Jupiter*'s Satellities almoſt coincide with the Plane of his Equator, the Diameter, determined by the Tranſit of the Satellite, is his greateſt; and the Diſtance of the Satellite, which ought to have been given in his mean Diameters, is aſſigned in his greateſt: For which Reaſon the Force of Gravity already found, muſt be augmented in the triplicate Ratio of his greateſt Diameter to his mean one; that is, if a repreſent the mean Diameter, and d the Difference of the longeſt and ſhorteſt, in the Proportion of $2a + 3d$ to $2a$ very nearly. Hence, as the centrifugal Force at his Equator, to the mean Force of Gravity on his Surface, ſo is Unity to $11\frac{5}{8} \times \frac{2a+3d}{2a}$. And (by Article 4.) $11\frac{5}{8} \times \frac{2a+3d}{2a} : 1 :: a : \frac{4}{5}d$, or $20aa = 186ad + 279dd$; which makes a to d, as 108 to 10; and thence the Axis is to the equatoreal Diameter, as $108 - 5$ to $108 + 5$, or as 103 to 113; that is, as 12 to $13\frac{1}{6}$: Which agrees nicely with the Obſervations of both Dr. *Pound* and Mr. *Bradley*, made with *Huygens*'s Long Teleſcope; the former making it as 12 to 13, and the latter as 25 to 27, which is very nearly the ſame. And if this Theory agrees ſo well with Obſervations in *Jupiter*, there is no doubt but it will be more exact in the Earth, whoſe Diameters are much nearer to Equality.

7. By Experiments made at *Jamaica* * in the Latitude of 18 Degrees with a very curious Clock, contriv'd by Mr. *Graham*, it was found that the *London* Pendulum went ſlower there by 2′ 6″ in a Sydereal Day, than at *London*. But it was found by Experiments made with Thermometers, that 9″ were to be allowed for the lengthening of the Pendulum by Heat; and therefore it was retarded only 1′ 57″ by the Decrement of Gravity. So that while a Pendulum of *London* makes 86164 Vibrations, the Number of Seconds in a Sydereal Day, the ſame at *Jamaica* only gives 86047 Vibrations. Therefore the Force of Gravity at *London* is to that in the Latitude of 18 Degrees, as the Square of 86164 to the Square of 86047; that is, very nearly as 1106 to 1103. And (by Article 1, and 2.) if a denote the mean Diameter of the Earth, d the Difference of the greateſt and ſmalleſt; $a - \frac{ccd}{rr}$ will denote the Force of Gravity in general in any Latitude, whoſe Co-ſine is to the Radius as c to r: Where, if in the Place of c there be ſubſtituted the Co-ſines of 51° : 32′ and 18° : 0′, that is of the Latitudes of *London* and *Jamaica*, we ſhall have the Force of Gravity at the former to that at the latter, as $a - \lfloor 3870\, d$ to $a - \lfloor 9045\, d$, that is as 1106 to 1103. Whence the mean Diameter of the Earth will be to the Difference of the

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* See *Tranſact.* N°. 432. p. 302.

Axis and equatoreal Diameter, as 191 to Unity ; and thence (by Article 4) as the mean Gravity on the Surface to the centrifugal Force at the Equator, ſo is 191 to $\frac{5}{4}$, or ſo is 239 to Unity. In order to ſhew that this cannot be, I ſhall obſerve, that when the Moon's Diſtance was ſuppoſed 60 Semidiameters of the Earth (as in Article 5.) it was found that the mean Force of Gravity was to the centrifugal Force at the Equator, as 289 to 1. But if the Proportion now found be true, the Moon's Diſtance of 60 Semidiameters muſt be augmented in the ſubtriplicate Proportion of 289 to 239, and then it will become 64 Semidiameters. In the like manner, if we compute the Ratio of the mean Force of Gravity to the centrifugal Force, by preſuppoſing the Magnitude of the Earth, as Sir *Iſaac Newton* and Mr. *Hugens* did, we muſt ſuppoſe a Degree to be above 80 *Engliſh* Miles to bring it out 239 to Unity. Now whereas it is certain that the Diſtance of the Moon is about 60 Semidiameters of the Earth, and that a Degree is leſs than 70 *Engliſh* Miles ; therefore, I ſay, that the Concluſion which ſeems to follow from the *Jamaica* Experiment, cannot be allowed to be true. And the Experiments made by *Richer*, in the Iſland of *Cayenna*, would ſtill make a greater Difference betwixt the Diameters of the Earth, than thoſe made in *Jamaica*: And the Lengths of the *Paris* and *London* Pendulums compared together, would make it greater than one 231 Part of the Whole, as it was found in Article 5.

8. From all the Experiments made with Pendulums, it appears that the Theory makes them longer

in Iſlands, than they are found in fact. The *London* Pendulum ſhould be longer when compared to the *Paris* one, than it really is: The *Jamaica* Pendulum, when compared to the *London* one, which vibrates in a greater Iſland, ſhould be longer than is found by Experience; and the Pendulum in *Cayenna* (a ſmaller Iſland than *Jamaica*) ſhould ſtill be longer. This Defect of Gravity in Iſlands is very probably occaſioned by the Vicinity of a great Quantity of Water, which being ſpecifically lighter than Land, attracts leſs in Proportion to its Bulk. And I find by Computation, that the Odds in the Pendulums betwixt Theory and Practice is not greater than what may be accounted for on that Suppoſition. I ſhall alſo obſerve, that although the Matter of the Earth were entirely uniform, yet the Hypotheſis of its being a true Spheroid is not near enough the Truth to give the Number of Vibrations which a Pendulum makes in twenty-four Hours. And ſuppoſe the true Figure were known, the Inequalities of Mountains and Vallies, Land and Water, Heat and Cold, would never allow Theory and Experiments to agree. But after the *French* Gentlemen who are now about meaſuring a Degree, and making Experiments with Pendulums in the North and South, ſhall have finiſhed their Deſign, we may expect new Light in this Matter.

III. Filtri *Lapidis* Mexicani *Examinatio et Comparatio cum aliis lapidibus facta, qua demonſtratur, nullum vel exiguum ejus uſum eſſe in depuranda aqua per illum colata.* *Auctore* Abrahamo Vatero *M. D. et P. P.* Societ. *Imper. Nat. Cur. et Reg.* Britann. *et* Boruſſ. *Socio.*

INTER exotica varia, ex utraque India advecta, quibus noſtrum imprimis aevum abundat, non poſtremum locum occupat Lapis Mexicanus, Filtrum dictus. Nomen iſtud obtinuit, quia ob poroſitatem ſuam liquoribus tranſitum permittit, ob quam cauſam ex fruſtis grandioribus excavatis, ollae aut mortaria formantur, quibus ad percolandos liquores, ſigillatim aquas potus loco uſurpandas, utuntur. Creditur enim, aquas per hunc lapidem filtratas, in tranſitu ab omnibus impuritatibus cohaerentibus liberari, clariores et puriores evadere, et ad ſalubritatem magis conferre. Haec eſt cauſa, quamobrem lapides hi in Japonia maximi aeſtimantur, et pari cum auro pretio venduntur, quia Japoneſes, qui nec de calculo nec de alio quocunque renum vitio ſciunt, ſuamque valetudinem caeteris fortunae bonis longe praeferunt, in ea ſunt opinione, iſtis in lapidem converſis fungis vim prolongandae vitae impreſſam eſſe, uti pluribus legitur *in Hiſtoria Filtri lapidis in* Valentini *Muſ. Muſeor.* Lib. I. Cap. 22. Accreſcit nimirum, quemadmodum loco citato recenſetur, in aliquibus Sinus Mexicani locis, centum circiter ulnas ſub undis, rupibus haec fungi ſpecies, qui ſponte in aere induratur et lapideſcit. Quid de hoc lapidis Filtri ortu ac creſcendi modo ſentiendum ſit, decernere nolo, quamvis ille admodum ſuſpectus et eum in finem excogitatus videatur, ne quis credat, vulgarem hunc eſſe lapidem. Duûm enim generum haec vaſa eſſe, aliqua coloris e nigro gryſei qualem poſſidet lapis ſciſſilis, quae ex Canada Americae provincia petita, pretio cariore veneunt, aliqua coloris tophacei, natale ſolum Italiam agnoſcentia, ſcribit *Lentilius in Ephemer. German Cent.* III. *Obſ.* CLXXVI. Imo teſte *Clerico* in Phyſica, uti nota ibidem addita teſtatur, effoditur etiam in agro Leodicenſi, plurimi in Hollandia uſus. Talis haud dubie eſt, cujus exiguum fruſtulum, nucis juglandis magnitudine, ante plures annos a B. Rittmeyero, Medico Amſtelodamenſi acceperam, cum quo tamen experimenta inſtituere non potui. Poſtquam vero illud in fundo infundibuli ex ſtanno confecti firmavi, eodem ad aquas curioſitatis gratia filtrandas uſus ſum. Ante breve temporis ſpatium autem doctiſſimus Ehrhart, Medicinae Doctor et Phyſicus Memmingenſis, ſelectum foſſilium dono mihi miſit, quae inter erat tophus ſingulariter poroſus, circa Memmingam reperiundus, qui, uti ille certiorem me fecit, quacunque ſui parte aquae immerſus, eandem avide imbibit. Quamprimum enim aquae ſuperficies eodem tangitur, aqua ſtatim vi preſſuræ aeris per totam ejus poroſam ſubſtantiam fertur et aſcendit, ut in ſaccharo, ſale, charta bibula et ſpongia hoc fieri, experientia docet. Suſpicio mox in mente enata eſt, annon forſan hic tophus Filtri Mexicani loco ad filtrandas aquas adhiberi poſſet. Hoc ut experirer, foveam in ejus fruſtulo excavavi, aquamque infudi, quam celerrime per ipſius poros tranſcolari vidi. In animum itaque induxi idem cum aliis tophis et lapidibus tentare, quo conſilio tubulos tophaceos oſteocollae ſumpſi, et obturato altero extremo, aquam indidi quae pariter occyſſime per poroſam ſubſtantiam tranſudabat. Recordabar porro, me ſpongiam a pluribus annis poſſidere, quam in thermis Carolinis degens, in canali, quo aquae ferventes ad balnea ducuntur, repoſueram, quo ipſo ſpongia ochra iſta, quam thermae ſecum vehunt et inter fluendum deponunt, incruſtata in tophum degeneravit. Hanc ſpongiam excavavi, et aqua foveam replevi, quae celerrime per illam defluebat. Hoc viſo, cum ipſo thermarum topho, cujus ſat magnum fruſtum poſſidebam, periculum facere conſtitui, quem in finem Lapidicidae excavandum tradidi, ut mortarium ex iſto formaret, quo conſtaret, an per iſtum tophum denſiſſimum, et ſolidiſſimum aqua tranſiret. Quod ſperavi, factum eſt, aqua enim infuſa eadem prorſus ratione, ac per Filtrum Mexicanum reliquoſque tophos, depluit, ſed tardius ob denſitatem lapidis filtratio per hunc ſuccedit, quam per tophos magis poroſos. Blandiebar mihi, me hoc experimento aliquid inveniſſe, quod ad generationem Filtri Mexicani ſub undis illuſtrandam facere poſſet. Quandoquidem enim tophus thermarum ex aquis iſtis ochram ſuam, fluendo per aquaeductus et ex iis deſtillando, deponentibus generatur, et ſenſim concreſcit, ſimili ratione mare fluctuoſum ſaxa quatiendo, ſalino-terreas partes deponere exiſtimavi, ex quorum ſucceſſiva concretione tophus hic generetur, rupibuſque potius accreſcat, quam quod fungi aut Agarici Saxalitis exemplo ex iiſdem propullulet.

pullulet.

pullulet. Sed quia lapidis hujus origo, uti ſupra vidimus, admodum dubia eſt, et certo non conſtat, utrum ille ex maris fundo educatur, an potius ex terra effodiatur nil certi de hoc affirmare audeo. Conſiderando vero inſignem tophi thermarum denſitatem, qua non obſtante aqua per illum fertur, in mentem venit, idem experimentum, cum ſaxo vulgari, quo in exſtruendis muris utimur, tentare. Expectationi reſpondit eventus, mortarium quippe ex tali ſaxo formatum inſervit mihi nunc loco Filtri Mexicani, per quod aquae aeque clarae, ac per illum, depluunt. Acquirebat quidem aqua hac ratione filtrata primum terreum ſaporem, qui tamen iterata filtratione ceſſavit, uti hoc etiam de iſto filtro lapidoſo annotavit laudatus Lentilius loco ſupra citato. Nullum etiam eſt dubium, alios quoque lapides id praeſtare poſſe, quia etiam ſilices duriſſimi et ſolidiſſimi quibus pavimenta in plateis ſternuntur, aquam imbibunt, uti tempore pluvioſo obſervamus. Hoc tamen manifeſtum eſt, et me tacente quilibet videt, tanto difficilius et tardius aquas infuſas poros eorum permeare, quanto ſolidiores denſioreſque ſunt lapides, anguſtioreſque eorum pori.

Sed nunc ad virtutem huic filtro lapideo adſcriptam accedimus, qua aquas per illud filtratas ab omnibus fecibus et impuritatibus liberari, aſſeritur. Ita enim *in ſupra citata Hiſtoria in* Valentini *Muſaeo* legitur, aquam per illum filtratam, quamvis infuſa fuerit limpidiſſima, ſemper aliquam fecum imperceptarum quantitatem deponere, ac ſenſuum indicio leviorem, puriorem, multumque ad valetudinem tuendam aptiorem evadere, immo multo diutius ſine glacie vegetam ac naturaliter

temporis

frigidam, ſine corruptione per longum temporis ſpatium poſſe conſervari. Haec ſi ita eſſent, et aquae hac ratione ab omnibus heterogeneis partibus liberari poſſent, omni pretio cariora cenſenda merito forent haec filtra. Quid enim quaeſo ad ſanitatem magis conducit quam aqua pura, in cibo potuque aſſumpta? Hoc tamen beneficio ingentes terrarum tractus carent, in quibus non niſi aquae ſalſae, nitroſae, vitriolicae et aluminoſae, ſubinde quoque aliis particulis mineralibus infectae ſcaturiunt, quae multis morbis anſam praebere poſſunt. Probabile omnino videtur, aquas tales filtratione per filtra ejuſmodi lapidea impuritates iſtas deponere, quoniam videmus, et experientia teſtatur, rivulos in locis arenoſis ſalebroſis et glareoſis ſcaturientes, ac per fundum talem oberrantes, multo limpidiores et puriores aliis fontibus eſſe. At enim vero aquae iſtae puritatem ſuam exinde non habent, quod impuritates ſuas ibidem tranſcolatione per arenam et glaream depoſuerint, ſed potius, quia inde nullas ſecum rapuerunt. Quod enim, ſalia non tantum, ſed horum ope etiam alia heterogenea corpuſcula, terrea, ſulphurea, mineraliaque, in aquis ſoluta et arcte cum iis ſociata, filtratione nullatenus ab iiſdem ſeparari queant, teſtantur experimenta chymica. Videmus quippe, corpora ſolidiſſima mineralia Mercurium, Antimonium, Saturnum, et alia in menſtruis ſoluta, per poros filtri chartacei penetrare, quae poſtea, praecipitatione a complexu aquearum abſtracta ac ex interſtitiis exturbata, ſeparantur, et filtratione repetita in filtro remanent. Sed forte quis objiciet, filtrum lapideum craſſius et denſius plus hic valere, quam papyraceum. Contrarium tamen teſtantur aquae, in fodinis et cryptis ſubterraneis ex ipſis ſaxis exſudantes et deſtillantes, quae mox lapideſcunt, unde Stalactites oritur. Ex hoc ſolo conſtat quam parum ſaxa ſolidiſſima, et conſequenter filtra lapidea valeant ad aquarum depurationem, et ſcoriarum ſalino-terrearum, mineraliumque ſeparationem in aquis omnimode ſolutarum. Non tamen negabo, aquas turbidas et limoſas filtratione per lapides iſtos claras & pellucidas reddi poſſe, quia impuritates iſtae non in aquis ſolutae et intimius cum iiſdem ſociatae ſunt, ſed tantum in illis fluctuant, iiſdemque innatant. Praeter has vero alias aquas hac methodo nullatenus puriores evadere, edoctus et confirmatus ſum, experimentis tam cum filtro ex *Hollandia* accepto, quam cum iſtis e topho thermarum *Carolinarum* et ex ſaxo vulgari formatis, iterato inſtitutis, percolando per illa aquas varias fluviatiles et fontanas, examinando ante et poſt filtrationem ope Hygrometri earum gravitatem, ſed nullam vel ſaltem inſenſibilem differentiam inveni. Fortunatum ergo praedico noſtrum imprimis ſolum, cui Numen propitium ſcaturigines limpidiſſimas et ſalutares conceſſit, ut adeo his filtris non indigeamus. Qui vero hac felicitate carent, iis melius conſuli non poteſt, quam ut aqua pluviatili, utpote per deſtillationem ab omnibus impuritatibus liberata adeoque omnium puriſſima ac defecatiſſima fruantur.

IV. *A Continuation of an Account of an Eſſay towards a Natural Hiſtory of* Carolina *and the* Bahama *Iſlands, by* Mark Catesby, *F. R. S. With ſome Extracts out of the ſeventh Set. By Dr.* Mortimer, *R. S. Secret.*

THE Account of the *Sixth Set* is printed in N°. 432. of theſe *Tranſactions* ; this *Seventh* begins at *Plate* 21, of Vol. II. which contains the

21. *Muræna maculata nigra* ; the black Murrey.

Lithophyton longè racemoſum ; *cortice flavo perforato.* This ſort of Plants is woody within, but covered with a yellow Coralline or ſtony Cruſt, or Bark.

22. *Turdus oculo radiato. Guaperva maxima caudata*, Willug. Tab. I. Fig. 23. The Old Wife. This is a Fiſh of the compreſſed ſharp-back'd kind, and is tolerable good Meat.

23. *Bagre*, ſecundæ Speciei *Marggravii* affinis ; The Cat-Fiſh ; ſo called (as I ſuppoſe) from the roundneſs of its Head which reſembles that of a Cat : Its Fleſh taſtes like that of an Eel, and is good Food.

24. *Haringus minor, Bahamenſis :* The Pilchard. Theſe are good to eat.

Arbor, Populi nigræ foliis, fructu reniformi, monoſpermo. This is a ſmall Tree, which grows near the Sea.

25. *Anthea quartus Rondeletii*, Will. 325. T. X 5. forte etiam *Orpheus veterum* ? Rondeletii, Geſn. 252 : The Mutton-Fiſh. This is reckon'd one of the moſt delicate Fiſh of the *Bahama* Iſlands.

26. *Remora.* Sloane's Nat. Hiſt. of *Jamaica*, Vol. I. p. 28. The Sucking-Fiſh. This is that Fiſh ſo famous for ſticking to the Sides of Ships, of which ſo many fabulous Stories have been related, particularly, that ſuch a ſmall Fiſh as this, being ſeldom more than a Foot in length, is able to ſtop a Ship under Sail, or a Whale when ſwimming: But our Author very juſtly remarks, that even ſeveral of them together can do no more than what Shells or Corals, and other Foulneſſes of the ſame Bulk, which make a Ship ſail ſomewhat the ſlower; and indeed in the ſame manner they may be ſome ſmall hindrance to a Whale. He ſays, he hath taken five of them off of the Body of a Shark, and hath ſeen them ſwimming about a Shark's Mouth, without his offering to devour them.

Phylanthos, Americana planta, *flores ad foliorum Crenas proferens.* Hort. Amſtel. Tom. I. 121. This grows on many of the *Bahama* Iſlands.

27. *Solea Lunata & punctata:* The Sole. This is much like our common Soles, only the Back is beautifully ſpotted with blue Spots, moſt of them in Form of Creſcents, with the hollow Part and Cuſps ſtanding oppoſite to each other.

28. *Orbis lævis variegatus:* The Glob-Fiſh. *Cornus, foliis Salicis Laureæ acuminatis, floribus albis, fructu* Saſſafras.

Phaſeolus minor lacteſcens, flore purpureo. Sloane's Nat. Hiſt. Jam. Vol. I. p. 182.

29. *Pſittacus Piſcis, viridis, Bahamenſis:* The Parrot-Fiſh; ſo called from the Shape of the Head, and its beautiful Variety of Colours, green, blue, red, and yellow. It is not much eſteemed for Food.

30. *Acus maxima, ſquammoſa, viridis :* The Green Gar-Fiſh.

Frutex aquaticus, floribus luteis ; fructu rotundo, quinque-capſulari.

31 An *Acarauna major, pinnis cornutis ?* an *Paru Braſilienſibus*, Marg.? Will. App. P T. o. 3? The Angel-Fiſh. This Fiſh is of the compreſſed kind ; but the moſt remarkable Particular about it is, that the larger Scales, which immediately cover the Body, are each of them covered by a great many very ſmall Scales : It is eſteemed an excellent eating Fiſh.

32. *Cancer terreſtris cuniculos ſub Terra agens.* Sloane's Nat. Hiſt. Jam. Vol. I. Tab. II. The Land-Crab. Theſe Creatures make Holes in ſandy Lands in the mountainous Parts ; but in breeding-time do annually come down from the Hills to lay their Eggs near the Sea : In their Journey they never turn aſide, but crawl over all Buildings they meet in their Way : they are of ſeveral Colours ; the lighteſt colour'd are reckon'd beſt to eat ; the black kind are poiſonous.

Tapia trifolia, fructu majore oblongo. The Crabs feed much on the Fruit of this Plant ; it nearly reſembles a Plumb.

33. *Cancellus terreſtris Bahamenſis* : The Hermit-Crab. The Claws and Fore-part of this Creature are cruſtaceous, but the Hind-part is only cover'd with a tender Skin ; Nature therefore hath taught them to chuſe empty Shells of the *Buccinum* kind for their Habitation, wherein they ſecure their Hind-part, and by a ſmall Claw at their Tail can keep themſelves faſt in their Shells, or quit them at pleaſure,

ſure, which they can be made to do by laying them near a Fire. Their living in ſuch Shells, like an Hermit in his Cell, hath given them the Name. Others call them *Soldier-Crabs*, reſembling them to Soldiers in Centinels Boxes. Roaſted in the Shell, they are eſteemed delicate Food. In the Plate is repreſented one of theſe Crabs in his Shell, another out of it.

Manghala, Arbor Curaſſavica, *foliis Salignis*. Hort. Amſt. Button-wood. Sloane's Nat. Hiſt. Jamaic. Vol. II. p. 18. The Hermit-Crabs are generally found in great Plenty under theſe Trees. The Wood is only uſed for Fuel.

Frutex trifolius, reſinoſus; floribus tetra-petalis, albis, racemoſis.

34. *Cancellus maximus Bahamenſis:* The Sea Hermit-Crab. This is much larger than the former, and inhabits the empty Shells of the largeſt ſorts of *Buccinums*. They are never obſerved to diſpoſſeſs any Fiſh of its Shell, and have therefore been undeſervedly compared to Soldiers who turn People out of their Houſes and plunder them.

Lithophyton compreſſum obſcurè luteſcens; marginibus purpureis, aſperis.

35. *Cancer arenarius:* The Sand-Crab.

Lithophyton pinnatum, purpureum, aſperum.

36. *Pagurus maculatus:* The red mottled Rock-Crab. Theſe Crabs cannot only run up the perpendicular Side of a Rock, but even under the projecting Parts of them with their Back downwards, as we ſee Flies upon the Cieling.

Cancer chelis craſſiſſimis; the rough-ſhell'd Crab.

37. *Cancer Marinus, chelis rubris:* The red-claw'd Crab.

Titanokeratophyton ramoſiſſimum ; cruſta eleganti, tuberculata. Theſe ſorts of Plants are cover'd with a ſtony calcarious Coat or Bark ; but the Subſtance within is ſemi-diaphanous, like Horn, and when ſet on fire, the Smoak ſmells exactly like that of Horns or Hoofs of Quadrupeds: And this is the moſt certain diſtinguiſhing Mark of all this Tribe of Sub-marine Plants called *Keratophyta.*

38. Here our Author premiſes ſome Obſervations relating to the *Sea-Tortoiſe* in general, as that our Sailors corruptly call them *Turtle* ; he mentions the ſeveral Species of them, and ſays that they are moſtly timerous, except in the Time of Coition, when they are furious and regardleſs of Danger. They uſually continue in Copulation for 14 Days together. In *April* they go on Shoar to lay their Eggs, whereof they drop above 100 in one Night into an Hole they have made in the Sand above two Feet deep, which they fill up again with Sand ; and in three Weeks the Eggs are hatch'd by the Heat of the Sun.

Teſtudo marina viridis : The green Turtle. This Sort is ſo called from the Colour of its Fat, and is preferr'd before all the other Kinds, being eſteem'd a very wholeſome and delicious Food. They feed on the following Plant ;

Alga marina, gramineo, anguſtiſſimo folio. Sloane's Nat. Hiſt. Jam. Vol. I. p. 61. Turtle-Graſs : It grows at the Bottom of the Sea in ſhallow Water.

39. Here our Author relates the Methods of taking Turtle, which is either by turning them on their Backs when they are upon the Sand out of the Water,

Water; or in the Water, by harpooning them; or by Men diving after them.

Teſtudo, Caretta. Rochefort. *Hiſt. des Antilles:* The Hawk's-Bill Turtle. This takes its Name from the Form of its Mouth. It is the Shell, or rather Scales of this kind, which are employed in ſo many beautiful Works, and ſo well known by the Name of Tortoiſe-Shell. I take this Opportunity to obſerve, that the hard ſtrong Covering which incloſes all ſorts of Tortoiſe is very improperly called a Shell, it being of a perfect bony Contexture, but cover'd on the out-ſide with Scales, or rather Plates of an horny Subſtance, which are what the Workmen call Tortoiſe-Shell.

40. *Teſtudo marina, Caouanna.* Raii Syn. Quadrup. p. 257. *The Logger-head Turtle.* Theſe are the boldeſt of all the Sorts of Turtle. They are voracious, very foul Feeders, and their Fleſh taſtes rank. They feed moſtly on Shell-Fiſh, their Beaks being ſtrong enough to break very large Shells.

Teſtudo Arcuata: The Trunk-Turtle. Here is no Figure of this Sort, becauſe the Author never met with one in the Country; but ſays, that in the Repoſitory of the Royal Society is a Turtle preſerved entire, which he takes to be of this Species.

V. Halo *obſervatus* Romæ *Anno* M DCC XXXII. *Die* XI. Auguſti *à D.* Did. de Revillas, *Regali Societati communicavit* Tho. Dereham *Bart.*

AB horâ antè Meridiem tertia uſque ad ſecundam poſt Meridiem ſimplex Halo undique terminatus, & graphicè circularis, ſolem in polo ejus exiſtentem cingere viſus eſt. Zonæ Latitudo apparentem ſolis diametrum æquare videbatur. Color intimus ruber, reliqui ſatis diluti, atque iis qui in Iride conſpiciuntur analogi, ſed in candorem deſinentes, & circa Meridiem aliquomodo immutati. Cœlum quamvis ſerenum, tenui caligine inficiebatur, Boreâ leniſſimè flante. Caligo deindè in albicantes nubeculas denſata, dum Halo evanuit, cujus Diameter ab interno Zonæ margine dimenſa, erat 45 gr.

Altitudo Barometri eodem die.

Hora A. M. 4. Digit. Paris	27.	11
In Meridie	27.	10 ½
Hora P. M. 2.	27.	10 ½

F I N I S.

TAB. 1.

Fig. 1.

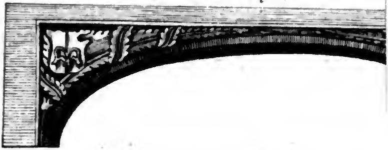
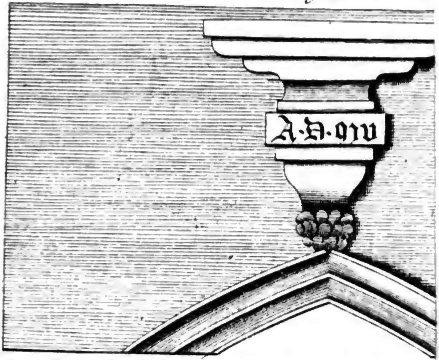


Fig. 2.



Indian	Antient
1	1
ν	2

A TABLE OF CHARAC

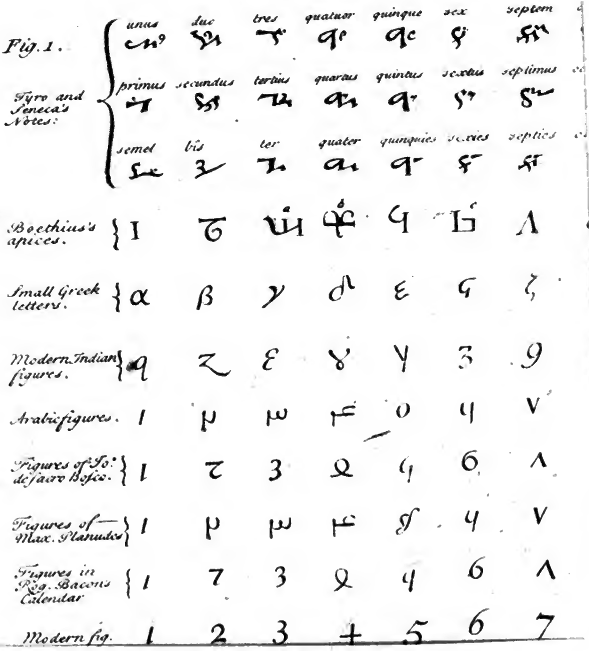


Fig. 1.
Tyro and Seneca's Notes:
unus
duo
tres
quatuor
quinque
sex
septem
primus
secundus
tertius
quartus
quintus
sextus
septimus
semel
bis
ter
quater
quinquies
sexies
septies
Boethius's apices.
Small Greek letters.
α β γ δ ε ϛ ζ
Modern Indian figures.
Arabic figures.
Figures of Jo. de Sacro Bosco.
Figures of Max. Planudes
Figures in Rog. Bacons Calendar
Modern fig.
1 2 3 4 5 6 7

Numb. 439.

PHILOSOPHICAL TRANSACTIONS

For the Months of *Octob. Novem.* and *Decemb.* 1735.

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II. *Remarks upon an* Antient Date, *found at* Widgel-Hall *near* Buntingford *in* Hertfordſhire, *on an* Oaken Plank; *now preſerved in the* Muſeum *of the* Royal Society, London. *By* John Ward, *Rhet. Pr. Greſh.* and *F. R. S.*

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V. A

V. *A Letter from Mr.* Colin Mac Laurin, Math. Prof. Edinburg. F. R. S. *to* John Machin, Aſtr. Prof. Greſh. & Secr. R. S. *concerning the* Deſcription of Curve Lines. *Communicated to the Royal Society on* December 21, 1732.

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N. B. The Papers hinted at by Mr. *Mac Laurin* p. 143. are printed in a Treatiſe entituled, *Exercitatio Geometrica de Deſcriptione Curvarum:* Authore *Gulielmo Braikenridge.* Londini, 1733. 4*to*.

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MDCCXXXVI.

I. *An Extract of a Letter from Mr.* John Cope *to Dr.* Alexander Stuart, *Phyſician in Ordinary to her* Majeſty, *Fellow of the* College of Phyſicians, *and of the* Royal Society, London, *concerning an* Antient Date *found at* Widgel-Hall *in* Hertfordſhire. *See* TAB. I. Fig. 1.

SIR, *Feb.* 25, 173$\frac{3}{4}$.

I Send you incloſed a Draught (ſee *Tab.* I. *fig.* 1.) of an ancient Chimney-piece (as I was informed it was) found on pulling down Part of *Widgel-Hall* in *Hertfordſhire:* There is cut upon it a Date expreſſed Part in *Roman* Numerals, Part in *Indian* Figures; which is the earlieſt Inſtance I have met with of the *Indian* Figures being uſed here in *England*, viz. 𝔐. 16. or 1016. that at *Colcheſter* being in the Year 1090. See *Philoſoph. Tranſact.* N°. 266. The Carving is very fair, the Letter 𝔐 and Figures project out above a quarter of an Inch. The whole Chimney-piece is of *Engliſh* Oak Plank, and is now very firm, though 718 Years old, and was never painted over; it is 4 Feet 3½ Inches long; the Part under the 16 was broken off in taking it down in *Auguſt*, 1733, when the Houſe was on fire. * * *

Your, &c.

John Cope.

II. *Remarks upon an* Antient Date, *found at* Widgel-Hall *near* Buntingford *in* Hertfordſhire, *on an* Oaken Plank; *now preſerved in the* Muſeum *of the* Royal Society, London. *By* John Ward, *Rhet. Pr. Greſh.* and *F. R. S.*

UPON the fourth of *April*, 1734, a curious Draught of an antient Date, carved in an Oaken Plank, at *Widgel-Hall*, the Seat of *Francis Gulſton*, Eſq; was laid before an Aſſembly of the Royal Society, as the moſt early Inſtance of our common Figures, uſually called *Arabian*, which had ever been obſerved in *England*. It was read 𝔐16, and thought to expreſs the Year 1016, the 𝔐 being taken for a *Roman* Numeral, and the 16 for *Arabian* Figures.

Doctor *Wallis* had, in the Year 1683, communicated to that learned Body the Draught of a Mantle-tree, ſomewhat like this, which he ſaw at the Parſonage-houſe at *Helmdon* in *Northamptonſhire*, and got it delineated. The Date, which was likewiſe carved in mixed Characters, expreſſed the Year 𝔐133, as the Doctor read it. *See* TAB. II. *Fig.* 2. This being the oldeſt Monument of that Sort, which had then been diſcovered among us, was publiſhed firſt in the *Philoſophical Tranſactions* [a], and afterwards in the Doctor's *Algebra* [b].

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[a] No. 154. [b] Cap. 4. p. 14.

And in the Year 1700 another Draught of a Date at *Colcheſter*, which had been ſent to Doctor *Wallis* by Mr. *Luffkin*, who copied it from the under Cell of a wooden Window, and read the Figures 1090, being all *Arabian*, was printed likewiſe in the *Tranſactions* [a], as more antient than the former. *See* Tab. II. *Fig.* 3.

None earlier than theſe two laſt had ſince appeared, till that from *Widgel-Hall*. Upon the Sight of which, I thought the Reading given to it looked very plauſible. The mixed Characters were no juſt Objection, which Doctor *Wallis* had accounted for in the *Helmdon* Date [b], and I have myſelf obſerved in ſome Manuſcripts. But yet one Difficulty ſeemed to remain, which was the want of ſome Character in the Place of Hundreds. And therefore ſoon after going into *Hertfordſhire*, I took that Opportunity to wait upon Mr. *Gulſton*, in order to ſee the Original; who was ſo obliging, as not only to ſhew it me, but alſo to ſay, if it would be acceptable to the Royal Society, it ſhould very readily be at their Service. I thanked him for the Offer; and promiſed, that if he pleaſed to ſend it to me, I would deliver it, as from him. Accordingly ſome Time after it came to my Hands, together with a Letter, giving an Account of the Antiquity of the Building in which it ſtood. And as that Letter may afford ſome Light to the Enquiry about the Date cut in the Plank, I take leave to ſend them both together.

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[a] No. 266. [b] De Algebra, cap 4. p. 14.

Part of a Letter from Francis Gulſton, *Eſq*; *to* Mr. John Ward.

S I R,

I Can give you no further Account of the Antiquity of the Building, than that in general 'twas eſteemed ancient. Before the Houſe was burnt, on the Timbers there were ſeveral old Coats of Arms; ſome we looked on as belonging to the Family of the *Scalers*; theſe were Poſſeſſors of *Widdihale*[a], with other Eſtates, ſoon after the Conqueſt. The Houſe, in Probability, might have been of greater Antiquity, and I believe really was; for at the Time of the Conqueſt 'twas in the Poſſeſſion of a conſiderable Follower of *Harold*.

The Piece of Timber I ſend you, was the Top of a Door-way, in a Timber-built Houſe, and plaſtered over with Mortar. From the Date on the plaſtered Wall, the Door had not been uſed at leaſt 343 Years; for on the Outſide was plainly to be ſeen the Date 1390. Part of the Room this was found in, was burnt too much to repair again. And in taking down the burnt Timbers, being preſent myſelf, I accidentally ſaw it, and obſerving the Date, thought it a Curioſity, that might give to the Curious ſome Speculation. And as ſuch I ſend it you, and am glad 'twill be acceptable to ſo learned a Body of Gentlemen, as the Royal Society. I am,

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[a] " *Widihale* in *Hertfordſhire* in the Time of the Conqueror was " Parcel of the Eſtate of *Hardwin de Scalers*, as appears by *Domeſdei Book*, fol. 141.

" It continued in that Family for ſeveral Generations, till it came " to *Anthony Widvile*, by the Marriage of the Daughter and Heir of " *Scalers*. But when he would not comply with *Richard* the Third to " deſtroy the young Princes, all his Lands were ſeized, and the " Mannor continued in the Crown, till *Henry* the Eighth granted it to " *George Canon* and *John Gill*: *George Gill*, the Son of *John*, marrying " the Daughter of *George Canon*, obtained the whole."

" In this Family it continued till the Beginning of the Reign of " *James* the Firſt, when it was ſold to *John Goulſton*, Eſq; whoſe De" ſcendants now hold it." *See Sir* Henry Chauncy's *Hiſtory and Antiquities of* Hertfordſhire, *p.* 111.

SIR,

Your moſt obedient

humble Servant,

Woodbridge in *Suffolk*,
July the 14, 1734.

Francis Gulſton.

Upon conſidering the Characters on this Plank, and thoſe of the other two Dates mentioned above, together with the Accounts given by learned Men of the Time when the *Arabian* Figures were firſt introduced into theſe Parts of the World, and the various Forms they have ſince received [*See* TAB. II. *Fig.* I.] I was at laſt ſatisfied, that none of theſe three Dates prove they were ever uſed among us, in leſs than an hundred Years after the Reading given to the lateſt of them. And the Reaſons which led me into this Opinion, I now beg Leave to offer, when I have firſt briefly inquired into their Origin and Antiquity.

Moſt Writers, who have treated of the Riſe of theſe Figures, have thought they came firſt from the *Perſians* or *Indians* to the *Arabians*, and from them to the *Moors*, and ſo to the *Spaniards*, from whom the other *Europeans* received them. This was the Opinion of *John Gerard Voſſius*[a], Mr. *John Greaves*[b], Biſhop *Beverege*[c], Doctor *Wallis*[d], and many others. And the *Arabians* themſelves own they had them from the *Indians*, as both Doctor *Wallis*[e] and Mr. *Greaves*[f] have ſhewn from their Writers.

But *Iſaac Voſſius* thought the antient *Greeks* and *Romans* were acquainted with theſe Figures, and that the *Arabians* took them from the *Greeks*, and the *Indians* from the *Arabians*[g]. For the Proof of this he refers to *Tyro* and *Seneca's Notes*[h], and the Treatiſe of *Boethius De Geometria*[i]. But as to the Notes of *Tyro* and *Seneca*, they ſeem to have no Affinity with theſe Figures, either in the Number or Nature of them; for they are not limited to nine, but are many Times that Number, and all different in Form. Nor are they ſimple Signs of Numbers, but complex Characters of ſeveral Letters of thoſe numeral Words which they ſtand for in the *Roman* Language, like our Short-hands; and therefore vary in their Shape, as they are deſigned to expreſs Cardinals, Ordinals, or Adverbs of Number. This will appear by the *Table of Characters* prefixed to theſe Papers, in which I have given the firſt ten of each. *See* TAB. II. *Fig.* 1. But as to what *Voſſius* ſais concerning *Boethius*, I obſerved in a curious Manuſcript of that Writer, now in the Library of Doctor *Mead*, nine Characters, which he tells us were invented and uſed by ſome of the *Pythagoreans* in their Calculations; while others of them made uſe of the Letters of the Alphabet for the ſame purpoſe. *Boethius* calls them *Apices vel Characteres*[a]. I have inſerted theſe alſo in the *Table* [TAB. II. *Fig.* 1.] to ſhew the great Affinity between them and the *Arabian* Figures, as theſe latter were writen two or three Centuries ago.

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[a] De Natura Art. lib. III. cap. 8. § 6.

[b] De Siglis Arabum & Perſarum Aſtronomicis, p. 2. *where the Form of them may be ſeen.*

[c] Arithmet. Chronolog. lib. I. cap. 5.

[d] De Algebra, cap. 3. p. 10.

[e] Ibid. p. 9.

[f] De Siglis Arabum, &c.

[g] Obſervat. ad Pomp. Mel. p 64.

[h] Vid. Grut. Inſcript. Vol. II. ad fin.

[i] Lib. I. ſub. fin.

The Opinion of *Daniel Huetius* differed from either of the former; for he imagined, the *Arabian* Figures were only the Letters of the *Greek* Alphabet corrupted and altered by ignorant Librarians[b].

From this ſummary Account of the Riſe and Antiquity of theſe Figures, it ſeems probable to me, they might owe their Original to the *Greeks* (thoſe common Maſters of all Science) and paſſing from them firſt to the Eaſtern Nations, come round to theſe Weſtern Parts, in the Manner before deſcribed. We have no other Author, who ſpeaks of this matter, near ſo antient as *Boethius*, whoſe Words are very expreſs, and much ſtrengthened by the Similitude of his Characters with the *Arabian* Figures. And therefore we may rather ſuppoſe, they took their Riſe from theſe, than from the ſmall *Greek* Letters, with which *Huetius* compared them; ſince theſe latter are neither ſo like them, nor ſo old as the Time of *Boethius*. And though what the

---

[a] Ubi ſupra. [b] Demonſtrat. Evangel. Prop. IV. c. 13. p. 172.

Arabians ſay may be true, that they had them from the *Indians*, and not the *Indians* from them, as *Iſaac Voſſius* conjectured; yet it may be equally true, that the *Indians* had them firſt from the *Greeks*, and thoſe *Arabian* Writers (who are not very antient) not have known it; nor are there any *Indian* Monuments of ſufficient Antiquity to render this Opinion queſtionable.

But which ſoever of theſe Sentiments may be eſteemed the moſt credible, with reſpect to the Origin of theſe Figures; *Joſeph Scaliger* thought they were not received by the *Europeans*, as they came of later Ages from the *Arabians*, long before the Year 1300[a].

But *John Gerard Voſſius* was of the Opinion they began to uſe them about the Middle of the thirteenth Century, or the Year 1250[b].

Father *Mabillon*, in his Treatiſe *De Re Diplomatica*, was neceſſarily led to attend to the Uſe of theſe Figures, particularly in Dates. And he informs us, that they were rarely uſed before the fourteenth Century, except in ſome few Books of Geometry and Arithmetic. And preſently after he ſais, it was not much to his purpoſe to treat of them, ſince he did not deſign to carry his Work lower than the thirteenth Century[c]. By which he ſeems to intimate, that he had met with very few, if any, Inſtances of *Arabian* Figures, in ſuch Inſtruments at leaſt, before the Year 1300.

But no one appears to have examined this Subject more carefully than Dr. *Wallis*; who has offered ſome Arguments to prove, that *Gerbertus*, a Monk, who was afterwards advanced to the Papal See, and took the Name of *Sylveſter* II, had before the Year 1000 learned the Art of Arithmetic, as now practiſed, with the Uſe only of nine Characters (whatſoever their Form then was) from the *Saracens* in *Spain*, which he afterwards carried into *France*[a]. But the Doctor thinks thoſe Characters or Figures were known for a long time after only to ſuch Artiſts, and principally uſed by them in aſtronomical Calculations; the *Roman* Numerals being ſtill retained in common Uſe to expreſs ſmaller Numbers[b]. Nor has he given us the Figures uſed by any of thoſe Writers, before *Johannes de Sacro Boſco*, who died in the Year 1256; and *Maximus Planudes*, a *Greek*, who flouriſhed after him; which I have copied from him, and inſerted in Tab. II. *Fig.* 1.

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[a] Lib. III. Ep. 223. [b] De Natur. Art. Lib. III. cap. 8. § 7.
[c] Lib. II. c. 28. §. 10.

Mr. *David Caſley*, in his *Catalogue of the Manuſcripts of the King's Library*, &c. has publiſhed a Specimen of a Manuſcript from the *Cottonian Library*, called *Calendarium Rogeri Bacon*[c], and dated 1292. The Figures in this Book are *Arabian*, and, as Mr. *Caſley* informed me, the oldeſt that he remembers to have met with in either of thoſe Libraries: For which Reaſon I have given them a Place in the *Table*.

It appeared to me exceeding difficult, how to reconcile the Opinions and Obſervations of theſe ſeveral Writers, concerning the firſt Uſe of the *Arabian* Figures in theſe Weſtern Countries, with the Time aſſigned even to the lateſt of the Dates above-mentioned. And it could not but ſeem very ſtrange, that no Date of any Writing ſhould have been produced in thoſe Figures, or any other Uſe of them diſcovered (except perhaps in ſome mathematical Calculations, or Books of Arithmetic) long before the fourteenth Century; and yet that a Date ſhould be found, ſo carved in a Piece of Wood, before the Middle of the twelfth Century, for ſo common a Purpoſe as the Mantle-tree of a Chimney.

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[a] De Algebra, c. 4. p. 17. [b] Ib. p. 11, 15, 16. [c] *Plate* xv.

But upon a cloſer Examination of the Characters, I found Reaſon to think, this was not really the Caſe; and that inſtead of 1133, they ought to be read 1233, what has been taken for a 1, being deſigned for a 2. This Reading ſeems to be confirmed by the Shape of the two 33; that follow it, from which, if the bottom Curve towards the right Hand (as it was often made formerly) was taken off, the upper Part would make the 2. Which Agreement between thoſe Figures is not only uſual at preſent, but often found in Manuſcripts of the fourteenth and fifteenth Centuries. Though ſometimes indeed 'tis otherwiſe; and the 2 has an Angle at the Top, when the 3 is round, which would not ſo well have ſuited this ſquare Hand. The Reaſon which occaſioned the carrying this Date ſo high, muſt, I preſume, have been the Similitude between the ſmall *i* over the preceding abreviated Word *Domini* and this 2. But though they appear to have ſome Likeneſs, yet there is a manifeſt Difference between them; for the 2 is much larger at the Top, where it has an Angle, and a Curve downward, that plainly diſtinguiſh it from the former. Could it be taken for a 1, I ſhould much rather ſuppoſe it was deſigned for a Letter than a Figure, and the two following Characters for a double *ll*; and ſo the whole to be only an Abreviation of the Word *milleſimo*. But as I think it muſt be a 2, for the Reaſons given already, and do not remember ever to have met with ſuch a double *ll*, I can't but eſteem the other the true Reading. And yet ſtill, I believe, this Date may claim the Preference of being the oldeſt of the Sort that has hitherto been diſcovered.

The Antiquity aſcribed to the *Colcheſter* Date, namely 1090, has, it ſeems, been occaſioned by a Miſtake in the Copy; for the 0 in the Place of Hundreds ſhould have been made a 4, by drawing down an oblique Stroke on each Side from the Bottom, which makes it 1490, before which Time the 4 had long received that Shape. *See* TAB. II. *Fig.* 1. I am obliged for this Information to *James Weſt*, Eſq; a worthy Member of this Society, and well skilled in our *Britiſh* Antiquities, who himſelf perceived the Miſtake in viewing the Original.

As to the Date from *Widgel-Hall*, which gave Occaſion to this Enquiry, it ſeems to me plainly intended to expreſs the Year 1000, and no more, by the *Roman* 𝔐 in the Eſcutcheon on the right Side. For the Characters in the other Eſcutcheon cannot, I think, ſtand for Figures, but muſt be the initial Letters of two Names I. G. as W. R. in the *Helmdon* Date; and were very probably deſigned in both to denote the Perſons who erected thoſe Buildings. The Omiſſion of a Character in the Place of Hundreds, is ſtill an Argument with me, that theſe two laſt were not made for Figures. But what I imagine puts the Matter paſt all Doubt, is the want of Evidence that the Figure 6 had received that Form till ſome Ages afterward: And when it was introduced, the upper Part was not at firſt made ſo erect, as it is here, but carried in a ſmall Arch juſt over the Top of the Circle, as may be ſeen in TAB. II. *Fig*. 1. On the other hand, what looks here like the modern 6, was at that Time the uſual Form of the Capital G. This I found fully confirmed by a large Collection of original Grants, made by our antient Kings and others, and preſerved in the *Cottonian* Library[a]. Upon conſulting theſe for half a Century at leaſt, both before and after the Year 1016, I found the G ſo written in a great Number of them, of which the following are ſome few Inſtances: *N*. 37. *anno* DCCCCLX. *N*. 35. *anno* DCCCCXCIII. *N*. 53. *anno* MXLV. *N*. 49. *anno* MLXXXI. For theſe Reaſons therefore I can make no Queſtion, but that Character was deſigned for a G, and not a 6. And it is plain from other Circumſtances in Mr. *Gulſton*'s Letter, that the Building might very probably be as antient as the Year 1000; which renders this Relic of it, conſidering how firm and ſound it ſtill is, a remarkable Curioſity.

The Uſe which I think may be made of theſe Obſervations is this: That ſo far as yet appears, any Coin, Inſcription, or Manuſcript, with a ſuppoſed Date before the thirteenth Century, expreſſed in *Arabian* Figures, may be juſtly ſuſpected either not to be genuine, or not truly read; unleſs the Antiquity of it be certain from other clear and undoubted Circumſtances, and the Date will bear no other Reading; and if it be a Copy, that it has been taken with Exactneſs.

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[a] Auguſtus II.

In TAB. II. *Fig.* 1 *contains the ſeveral different Characters and Figures refer'd to in the* REMARKS, *together with the modern* Indian *and* European *Figures.*

Fig. 2 *is the* Helmdon *Date.*

Fig. 3 *is the* Colcheſter *Date.*

III. *Some Conſiderations on the* Antiquity *and* Uſe *of the* Indian Characters *or* Figures.

By Mr. John Cope.

THE moſt ingenious Invention of Figures by the ſagacious *Indians*, is of ſuch vaſt Importance in Numbering, that it can never be ſufficiently enough admired, although now-a-days the Uſe of them is become ſo familiar among us, that very few conſider what a Loſs the want of them would be to People of every Degree and Station in Life: For to conſider only, that ſuch a Number as not long before the Conqueſt would take up a good Arithmetician whole Days to count by the literal Characters, is now by the Help of Figures commonly expreſs'd by a Child in a few Minutes. This Conſideration of the vaſt Uſe of Figures, put the Learned Dr. *Wallis*, and others ſince him, upon enquiring at what Time they were firſt happily introduced into this Iſland.

Dr. *Wallis* informs us, that we had the Figures from *Spain*, into which Nation they were brought by the *Moors*; the *Moors* had them from the *Arabians*; and the *Arabians* from the *Indians*. And it was the Doctor's Opinion, that they were firſt brought into *England* about the Year 1130; for that the firſt Inſtance of their Uſe which he had met with, was a Date upon a Chimney-piece, which Date was 𝔐 133, the Character 𝔐 which the *Romans* made uſe of to expreſs 1000, being mix'd with Figures, as Dr. *Wallis* obſerves, was often done at their firſt coming in; ſince that in *Philoſophical Tranſactions*, N°. 266, is mentioned a Date 1090. all in Figures. About twelve Months ago I produced a Date upon a Chimney-piece at *Widgel-Hall* in *Hertfordſhire*, which was 𝔐 16, the 𝔐 for the 1000, being here again mix'd with Figures. And I now produce a ſtill earlier Inſtance of the Uſe of Figures in *England*, [*ſee* TAB. I. *Fig.* 2.] which is a Draught of an Inſcription over a Gate-way at *Worceſter*, built, as 'tis believ'd, in the Reign of King 𝔈𝔡𝔤𝔞𝔯, and is this 975. (nine Hundred Seventy-five) which is 158 Years before the Date of Dr. *Wallis*'s, 41 Years before that I produced laſt Year, and is now 760 Years ſtanding. It is a great pity (I think) but it ſo happened, that the Shape of the Figures in this Date were altered from what they are here ſhewn to be of, about two Years ago, when the Gate was new chipp'd and beautified; and at the ſame Time the modern ones 975 were then painted in their Room, as they are now to be ſeen; the Ground is Gold, and the Figures black. The Account of this Date I had given me lately by

Mr. *Joſeph Dougharty* of *Worceſter*, who is an ingenious and reputable Perſon, and lives in the Houſe over the Gate-way on which this Inſcription is: He likewiſe inform'd me, that his Houſe goes by the Name of *The oldeſt Houſe in five Counties*; and it is the current Opinion thereabouts, and reported by the ancient People in that Place, That the Houſe was built by King *Edgar*, wherein they ſay, --- he ſometimes kept his Court. I confeſs I am not ſo well acquainted with the Hiſtory of thoſe Times, as to ſay whether King *Edgar* either built, or kept his Court there; but all Hiſtorians agree that *Worceſter* was then a very conſiderable Biſhoprick ; and that *Dunſtan* and *Oſwald*, who were both ſucceſſively Biſhops there in *Edgar*'s Time, were both his great Favourites, eſpecially *Dunſtan*, for whom King *Edgar* had a very great Regard: for it appears that the firſt Thing *Edgar* did after he came to the Crown, was to recal *Dunſtan* from *Flanders*, where he had been three Years in Exile, and was immediately thereupon made Prime Miniſter, Favourite, and Confeſſor, at firſt Biſhop of *Worceſter*, and afterwards Archbiſhop of *Canterbury*; upon which laſt Promotion his great Friend *Oſwald* ſucceeded him in the See of *Worceſter*: And 'tis very likely that either *Dunſtan* or *Oſwald*, as having ſo much Power, Intereſt and Riches, might erect a Building there, of which this Gate-way might have been a Part; for as *Edgar* died in the ſame Year 975, if we ſuppoſe the Date to be fix'd upon the Building the Year it was finiſhed, as is now commonly done, *Edgar* could not live or keep his Court there, unleſs it was in ſome Part of that Year in which we ſuppoſe it to be finiſhed.

I ſhall next mention ſome Obſervations upon the different Shape the Figures have been altered to ſince their coming into theſe Weſtern Parts; for our Anceſtors wrote them different from the *Indians*, and we again make ſome of them different from what our Anceſtors did, as by the following Table will appear. See Tab. I. *Fig.* 3.

In this Table the Left-hand Column contains the *Indian* Characters; the Middle thoſe uſed by our Fore-fathers, as appears by old Weſtern Manuſcripts; the Third are the Characters we now uſe.

We may now obſerve that the Figure 1, is the ſame as the *Indian*; the Figures 2 and 3, are the ſame with the *Indian*, only placed in a different Poſition, for the ſake of writing them more readily, for only the Daſh from the *Indian* ʒ is taken away; they are only, as we may ſay, both ſet upright. So the Character ⊊ of the *Indians* is much the ſame with ours, only we cloſe the Head, and ſet it upright, thus 4. Again, our Anceſtors transferr'd the Figure -ϑ (5) from the Place of 5, to that of 8, and with very little Alteration is our 8 made from it. As the Figure Five was moved into the Place of Eight, ſo the old Eight ʎ 7 was moved into the Place of Seven, the firſt of theſe is the 7 of our Anceſtors, the laſt 7 is our own; and as they put the Five for an Eight, they put the ſix ɥ into the Place of five; which ɥ was at length altered to ђ, and laſt of all to 5. The two Characters 9 and o are without any Alteration, except that our Anceſtors ſtruck a Line croſs the Cypher, as thus -θ-, which we now leave out, and by that means 'tis reſtored to its antient Form. And now we have no Figure left but the *Indian* V (7) to derive the modern 6 from, to which it ſeems to have no manner of relation: I ſhall only obſerve, that it ſeems not unlikely to be compounded of the *Indian* o (5) and the 1, as thus, 6; for of the two antient Characters o ϑ (for five) the o is *Indian*, and the ϑ is *Arabian*; this laſt being nothing more than the *Arabian* Letter ϑ inverted, which in the *Arabian* Alphabet denotes the ſame Number, and is, as 'tis ſuppoſed, uſed by the *Arabians* only.

The *Roman* Characters have likewiſe undergone Alterations; for it is found that 1000 was repreſented by the Antients by this Character ↀ, as likewiſe by M; whence is derived the modern M. for that Number: Alſo 5000 was repreſented by ↁ, and 50000 by ↇ; and hence the modern Characters IↃↃ and IↃↃↃ for the ſame Number. We find alſo in antient Inſcriptions ⋇ or ⋇ ſtand for 20, and ⋕ 30, the Letter X being twice expreſs'd in the one, and three times in the other, which the Moderns write ſingle, as XX and XXX, only the Timber-Merchants uſe the antient Characters ⋇ and ⋕ to this Day.

IV. *Remarks upon an* Antient Date, *over a Gate-way, near the Cathedral, at* Worceſter. *By* John Ward, *Rhet. Prof. Greſh. and F. R. S.*

UPON the 27th of *February* laſt, I had the Honour to lay before this Society a Paper, containing ſome Remarks upon an antient Date, carved in Wood, that was found at *Widgel Hall* near *Buntingford* in *Hertfordſhire*, with the Characters M16; which had been read 1016, ſuppoſed to be mixed Numbers, the M *Roman*, and the two others *Arabian* or *Indian*, as they are indifferently called. This led me to conſider two other Dates of the like Kind, formerly publiſhed in the *Philoſophical Tranſactions*; one found at *Helmdon* in *Northamptonſhire*, in mixed Characters expreſſing, as was thought, M133; and the other at *Colcheſter*, ſaid to denote the Year 1090, wholly in *Arabian* Figures. But upon ſearching into the Origin of thoſe Figures, and the Time when they were firſt brought into theſe Parts of the World, I could meet with no Examples of them in any Manuſcripts, before ſome Copies of *Johannes de Sacro Boſco* (mentioned by Dr. *Wallis*) who died in the Year 1256, which was 123 Years after the lateſt of the three Dates abovementioned. As it could not therefore but ſeem very ſtrange, that Workmen ſhould have made Uſe of thoſe Figures for ſuch common Purpoſes, ſo long before they appear in the Writings of the Learned; ſo upon a cloſer Examination, and further Inquiry, I found there was no Reaſon from any of theſe Dates to ſuppoſe, it was really true in Fact. For the *Helmdon* Date inſtead of 𝔐133, ſhould, as I then ſhewed, be read 𝔐233; the *Colcheſter* Date 1490, inſtead of 1090; and that at *Widgel Hall* has no *Arabian* Figures in it, the Characters 1 and 6 not being Numbers, but the initial Letters of two proper Names I G, in the uſual Form of thoſe Letters in that Age.

But there has been very lately read before this Society, an Account of a Date at *Worceſter*, more antient than any of the three former; namely 97𝔳, or 97v, in which the Unite is a *Roman* Numeral, and the other two are taken for *Indian* Figures. I obſerved in my former Paper, that ſuch Mixtures were ſometimes found in antient Numbers; tho' in what Manner they were ſo uſed, I did not then explain, but for Brevity contented myſelf with refering to the *Algebra* of Dr. *Wallis*, a Book ſo very well known. The Doctor thought it neceſſary to take Notice of this, in Order to account for his Way of reading the *Helmdon* Date, in which the 𝔐 only is a *Roman* Numeral. And I had myſelf met with a few Inſtances of it in Dr. *Mead's* Manuſcript of *Boethius*, as ccc29 and dcc68, where the Hundreds are numeral Letters, and both the Decimals and Unites *Arabian* Figures[a]. But 'tis obſervable, this is not done promiſcuouſly, but the largeſt Numbers are always Letters, and the leſſer, Figures; as in the *Helmdon* Date. And *Mabillon* has obſerved, that in a curious manuſcript Copy of *Thomas a Kem-*

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[a] De Arith. Lib. II.

pis, writen in the fifteenth Century, ſome of the Pages are ſo numbered [a]. Which Method, ſo far as appears, was always attended to, and never in any one Inſtance inverted. So that this *Worceſter* Date, which has a *Roman* Numeral in the Place of Unites, and the two preceding Characters are ſuppoſed to be *Indian* Figures, is not only without Example, but directly contrary to all other Inſtances of ſuch mixed Numbers. Which Conſideration alone might be a ſufficient Ground to think, there muſt be ſome Miſtake in the Reading.

But the middle Figure, taken for a Seven, is as remarkable; which turning towards the left Hand, forms two obtuſe Angles, one above, and the other below. This Shape of the Seven, I believe, was never ſeen before, and ſeems by no means to ſuit that Age. In the Specimen of the Figures taken from *Johannes de Sacro Boſco*, by Dr. *Wallis*, which may be ſeen in the Table annexed to my former Paper [*See* TAB. II. *Fig.* 1.] the Figure Seven is made in this Form Λ, like the two Legs of an iſoſceles Triangle. And in *Roger Bacon*'s *Calendar*, dated 1292, there is only this Variation; that the Leg to the left Hand is ſomewhat ſhortened, as will appear likewiſe by the ſame Table. And this Form continued till Printing was introduced among us; as is evident from *Caxton*'s *Polychronicon*, and other Books printed about that Time. Nor do I find it till later Times in any other Shape; unleſs that in Biſhop *Beverege*'s Table of *Indian* Figures, the two Legs of our antient Seven are drawn parallel, and arched at the Top, in this manner ∩, inſtead of meeting in an Angle[a]; and *Planudes*, a *Greek* Writer, has kept the true *Arabian* Form V, like the *Roman* Five, which the *Europeans* inverted. [See TAB. II. *Fig.* 1] The laſt Alteration this Figure received among us, was by raiſing the ſhorter Leg horizontally. But no Inſtance of it parallel to this in the *Worceſter* Date, or any Thing like it, has before appeared. As there ſeems therefore no Reaſon to ſuppoſe it a Seven; ſo I think a probable Conjecture may be offered, what it was deſigned for, and that is, the *Roman* Numeral Ten, which was made in this Form, like an X; to which Character, in our old ſquare Hand, this ſuppoſed Seven ʅ would very well agree, by ſupplying only the two extreme Parts to the right Hand, in this Manner X, which may eaſily be thought to have been decayed, and worn away by length of Time.

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[a] De Re Diplom. Tab. XV.

As there is no Reaſon to take the middle Character for a Seven, ſo neither is there any to ſuppoſe the firſt was intended for a Nine, being thus placed before two *Roman* Numerals, as I take them both to be. It has indeed ſome Similitude with that Figure; but that is nothing more, than what was antiently, and ſtill is, common to the Letter ꝏ in that Hand, which reſembles a double O, with an oblique Stroke turned inwards from the Bottom of that to the right Hand; ſo that if the other to the left be taken away, that which remains will appear in this Form Ꝗ, like what is here called a Nine. And every one knows, who has any Acquaintance with antient Inſcriptions, that Letters frequently periſh in this Manner, one Part before another.

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[a] Arith. Chron. Lib. I. Cap. 4.

Upon theſe Suppoſitions the true Reading would be MXV. But ſince the old Date is now deſtroyed, and modern Figures put in its Place, this muſt remain uncertain. And I can't but think, the former Characters muſt have been very dark and obſcure, for the following Reaſons. There is, as I am informed, a Tower over this Gate, of which a curious and learned Gentleman, who lives very near it [a], has lately given ſome Account, in a Treatiſe entitled, *A Survey of the Cathedral Church of* Worceſter. He ſais, it is “ commonly called King *John*'s “ Tower, and ſaid by ſome to be built by him ; “ but it was much more antient, having in the Front “ of it the Statues of King *Edgar*, and his two “ Queens, *Ethelfleda* and *Ethelfrida* ; and the “ Street it leads into, is called in ſeveral Writings “ *Edgar-ſtreet*” [b]. Could there be any Room for its being ever ſuppoſed to have been built by King *John*, while this Date was plain and clear ? Or would the Author of the *Survey* have contented himſelf with only ſaying, *it was much more antient* ; when he could ſo eaſily have given us the Year, had he been ſatisfied with the Reading ? King *Edgar* had been a great Benefactor to the cathedral Church at *Worceſter*, and is ſaid to have given to it 300 Hides of Land [c] ; which ſome compute at ſo many 100 Acres, but my Lord *Coke* ſais, an Hide contains no certain Number. *Edgar* died in 975, but his Queen *Ethelfrida* ſurvived him ſeveral Years. And as it is not unuſual, in Order to perpetuate the Memory of public Benefactors, to erect Statues and other Monuments of them, after they are dead; it might be ſo in this Caſe, and the Street receive its Name (for ſome Time at leaſt) from this Building, like our *Ludgate-ſtreet.* But tho the preciſe Year of this Date can't, I fear, now be determined with certainty; it is ſufficient to have ſhewn, that neither the Order of the Characters, their Shape, nor the oldeſt Examples of *Arabian* or *Indian* Figures, any where found, do in the leaſt countenance the Reading given to it; but, on the contrary, all of them afford the higheſt Probability, that it can't be genuine.

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[a] *Dr.* William Thomas. [b] Pag. 7. *See likewiſe* Hearne's *Preface to* Heming's Chartularium, *in the Frontiſpiece of which Treatiſe is a Draught of thoſe three Figures.* [c] *Account of the Biſhops of* Worceſter. *By Dr.* William Thomas.

I beg leave only to add, that two learned and ingenious Gentlemen of this Society, *Roger Gale* and *James West* Eſquires, to whoſe Judgment I would pay a due Regard, were pleaſed to tell me, they thought the two firſt Characters, taken for a Nine and a Seven, might probably have been nothing but an ∞; which will bring the Date to 1005, ten Years nearer the Time of *Edgar.* My only Difficulty as to that Reading is, that the ∞ would then have two oblique Strokes prolonged from the Bottom, one in the Middle, beſides the other uſual one towards the right Hand, which I do not remember ever to have met with. But as this Inacuracy might ariſe from the Obſcurity of the Character, or the Imagination of its being two *Arabian* Figures; I leave it to the Curious to judge either way, as they pleaſe, both Sentiments equally ſuppoſing the original Characters of this Date muſt have been *Roman* Numerals.

I ſhould not have enquired farther into this Subject upon the preſent Occaſion, but that I apprehend it to be a Matter of ſome Conſequence, eſpecially with Relation to Manuſcripts. A Copy, for Inſtance, of ſome antient Author, writen in the Year 1375, and dated in *Arabian* Figures, by changing only the 3 into a Cypher, may be carried back three hundred Years; or by making it a Nine, and taking out the 1, may be raiſed ſtill a Century higher, to 975, the ſuppoſed Year of the *Worceſter* Date. And thoſe, who are converſant with Manuſcripts, are ſenſible, that the Age of them can't always be determined barely by the Hand. Since therefore *Arabian* Figures are in moſt Caſes much more eaſily falſified, than *Roman* Numerals; I humbly preſume, too great Caution cannot be uſed, in admiting any Inſtances of them more early, than have been yet diſcovered, but upon very clear and ſufficient Evidence.

V. *A Letter from Mr.* Colin Mac Laurin, Math. Prof. Edinburg. F. R. S. *to Mr.* John Machin, Aſtr. Prof. Greſh. & Secr. R. S. *concerning the* Deſcription of Curve Lines. *Communicated to the Royal Society on* December 21, 1732.

I Am informed that ſome Papers have been preſented to the Royal Society of late, concerning the Deſcription of Curves, in a manner that has a near affinity to that which I communicated to them of old, and have carried farther ſince; and that it would not be unſeaſonable, nor unacceptable, if I ſhould ſend an Account of what I have done further on that Subject ſince the Year 1719. The Author of thoſe Papers taught Mathematicks here privately for ſome Years, and ſometime ago (*viz.* in 1727.) mentioned to me ſome Theorems he had on that Subject; which, at the ſame time, I ſhewed him in my Papers. Some time before that, he ſhewed me a Theorem which coincided with one of thoſe in my Book, tho' he ſeemed not to have obſerved that Coincidence; and indeed Methods of that kind, are often found coincident that do not appear ſuch at firſt ſight. I am unwilling to be the Occaſion of diſcouraging any thing that is truly ingenious, and renounce any Pretenſions of appropriating Subjects to my ſelf; but, on the contrary, wiſh Juſtice may be done to every Perſon, or to any Performance in Proportion to it Merit; yet I find it is fit I ſhould take Precautions, leſt any one ſhould take it in his head afterwards to ſay, I take things from him which I may have had long before him; and therefore ſhall ſend you an Abſtract of what I have done in relation to this matter, ſince the Year 1719.

I have ſo much on this Subject by me, that I am at a loſs what to ſend; but at preſent I ſhall only give you an Abſtract of thoſe Propoſitions, which I take to be more nearly related to thoſe which this Author has offered to the Society from the Converſations I had with him. You know that in 1721, I printed ſeveral Sheets of a Supplement to my Book on the Deſcription of Curve Lines, which I have never yet publiſhed, having been engaged for the moſt part in Buſineſs of a different nature, and in Purſuits on other Subjects ſince that time. I ſhall firſt give you an Abſtract of that Supplement, as far as it was then printed, and ſhall ſubjoin to this, an Account of ſome Theorems I added to it the following Year, *viz.* in 1722. I was led into thoſe new Theorems by Mr. *Robert Sympſon*'s giving me at that time a Hint of the ingenious Paper, which has been ſince publiſhed in the Philoſophical Tranſactions. I had tried in the Year 1719, what could be done by the Rotation of Angles on more than two Poles; and had obſerved, that if the Interſections of the Legs of the Angles were carried over Right Lines, as in Sir *Iſaac Newton*'s Deſcription, the Dimenſions of the Curve were not raiſed by this Increaſe of the Number of Poles, Angles, and Right Lines; and therefore neglected this at that time, as of no uſe to me; confining my ſelf to two Poles only, and varying the Motions of the Angles as you find them in my Book. I found this by inquiring in how many Points the Locus could cut a Right Line drawn in its Plane, and found, by a Method I often uſe in my Book, that it could meet it in two Points only.

Having found then, that three or more Poles, were of no more Service than two, while the Interſections were carried over fixed Right Lines; I thought it needleſs to proſecute that Matter then, ſince by increaſing the Number of Poles, my Deſcriptions would become more complex without any Advantage. But in *June* or *July*, 1722, upon the Hint I got from Mr. *Sympſon* of Mr. *Pappus*'s Poriſms, I ſaw that what he has there ingeniouſly demonſtrated, might be conſidered as a Caſe of the above-mentioned Deſcription of a Conick Section, by the Rotation of any Number of Angles about as many Poles; the Interſections of their Legs, in the mean time, being carried over fixed Right Lines, excepting that of two of them which deſcribes the Locus. For by ſubſtituting Right Lines in place of the Angles, in certain Situations of the Poles and of the fixed Right Lines, the Locus becomes a Right Line; as for Example, in the Caſe of three Poles, when theſe three are in one Right Line, in which Caſe the Locus is a Right Line, which is a Caſe of the Poriſm.

'Twas this led me to conſider this Subject anew; and firſt I demonſtrated the Locus to be a Conick Section algebraically; and found Theorems for

drawing

drawing Tangents to it, and determining its Aſymptotes. I alſo drew from it at that time a Method of deſcribing a Conick Section through five given Points [a]. This encouraged me to ſubſtitute Curves for the Right Lines, to ſee if by this Method I could be enabled to carry on my Theorems about the Deſcriptions of Lines through given Points to the higher Orders of Lines. Some of the Theorems I found at that time, I now ſend you. In *November* 1722, looking into Sir *Iſaac's Principia*, I ſaw that the Deſcription of the Conick Section by three Right Lines, moving as above, about three Poles, could be immediately drawn from his 20th Lemma, which itſelf is a Caſe of this Deſcription. This gradually led me to ſeek Geometrical Demonſtrations for the whole, as far as it related to the Conick Sections. I ſend you ſome Leaves of this Paper dated at *Nancy*, *November* 1722. Since that time, I have not added much to this Subject, but what relates to the drawing Tangents, determining the Aſymptotes, and the *Puncta Duplica*, or *Multiplicia* of theſe Curves. I conſidered it the leſs, that I did not find it more advantageous in any reſpects, than the Method I had conſidered in my Book, or more general.

In 1727 I added to a Chapter in my Algebra, which is very publick in this Place, an Algebraick Demonſtration of the Locus, when three Poles are employed; and the Method of deſcribing a Conick

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[a] *The Paper on this Subject I have, is dated* July 31, 1722, *at Sea, being then in my way to* London, *going for* Cambray.

Section through five given Points, ſubjoining at the ſame time, that if more Poles are employed, and Angles or Right Lines, the Locus was ſtill a Conick Section; which I thought was a remarkable Property of the Conick Sections not obſerved before.

Theſe Things I intended to put in order, and publiſh in the Supplement to my Book, a Part of which has been printed ſince the Year 1721. I have in my view alſo to give ſeveral other Things in that Supplement; two of which, I ſhall only juſt mention at preſent, becauſe I believe they are foreign to the preſent Affair. I ſubjoin a Problem determining the Figure of a Fluid, whoſe Parts are ſuppoſed to be attracted to two or more Centers; and a Solution of a general Problem about the Colliſion of Bodies.

The Author of the Papers given in to the Royal Society, will not refuſe that I ſhewed him the Theorems, I now ſend you, in 1727. He owned it laſt Summer at leaſt: I am to publiſh theſe very ſoon. Whether he has carried the Subject farther, I leave to the Judgment of the Gentlemen to whom they were referred. As to the Demonſtrations, it would take ſome time to put them in a proper Form to be publiſhed. You who have ſo nice a Taſte of Demonſtrations, will eaſily allow, that it ought not to be done in a hurry. I could ſend thoſe that are Algebraick eaſily; but do not care to ſend thoſe that are Geometrical, till I have leiſure. I could not have been called to this in a worſe Seaſon of the Year than now, when I begin my Claſſes, and have few Minutes in the Day my own. I ought to make an Apology for this long Letter; but thought you was the Perſon of my Acquaintance moſt proper to ſend this to. I am, with great Eſteem,

SIR,

Your moſt obedient

moſt humble Servant,

Colin Mac Laurin.

An Abſtract of what has been printed ſince the Year 1721, as a Supplement to a Treatiſe concerning the Deſcription of Curve Lines publiſhed in 1719, and of what the Author propoſes to add to that Supplement.

I. IN the firſt Part of the Supplement, there is a general Demonſtration given of the Theorem, that if two Lines of the Orders or Dimenſions, expreſs'd by the Numbers m and n, be deſcribed in the ſame Plane, the greateſt Number of Points in which theſe Lines can interſect each other, will be $m n$, or the Product of the Numbers which expreſs the Dimenſions of the Lines, or the Orders to which they belong.

II. In the next Part, Theorems are given for drawing Tangents to all the Curves that were deſcribed in that Treatiſe by the Motions of Angles upon given Lines. Their Aſymptotes are alſo determined by more ſimple Conſtructions than thoſe which are ſubjoined to their Deſcriptions in that Treatiſe. Of theſe we ſhall give one Inſtance here.

Suppoſe the invariable Angles (*Fig.* 1 and 2) F C G, K S H, to revolve about the fixed Points or

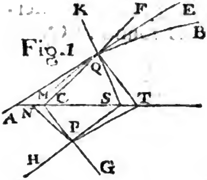


Fig. 1

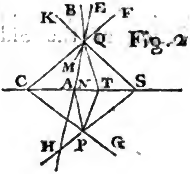


Fig. 2

Poles, C and S. Suppoſe the Interſection of the two Sides C F, S K, to be carried over the Curve B Q M, whoſe Tangent at the Point Q is ſuppoſed to be the Right Line A E; and let it be required to draw a Tangent at P to the Curve Line deſcribed by P the Interſection of the other two Sides C G and S H.

Conſtruction. Draw Q T conſtituting the Angle S Q T, equal to C Q A, on the oppoſite Side of S Q, that Q A is from C Q; and let Q T meet C S (produced if neceſſary) in T. Join P T, and conſtitute the Angle C P N equal to S P T, on the oppoſite Side of C P, that P T is from S P, and the Right Line P N ſhall be a Tangent at P, to the Curve deſcribed by the Motion of P, which is always ſuppoſed to be the Interſection of C G and S H.

The Aſymptotes of the Curve, deſcribed by P, are determined thus. Find, as in the abovementioned Treatiſe, when theſe Sides become parallel, whoſe Interſection is ſuppoſed to trace the Curve; which always happens when the Angle C Q S becomes equal to the Supplement of the Sum of the invariable Angles F C G, K S H, to four Right ones, becauſe the Angle C P S then vaniſhes. Suppoſe (in *Fig.* 3 and 4,) that when this happens, the Interſection of the Sides C F, S K is found in Q.

Fig. 3

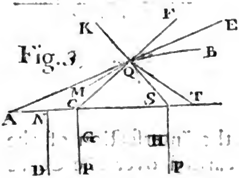
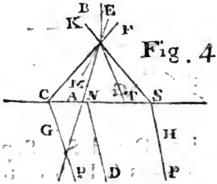


Fig. 4

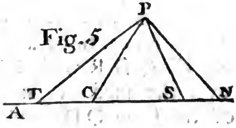


Conſtitute the Angle S Q T equal to C Q A, as before, and let Q T meet C S in T. Take C N equal to S T, the oppoſite Way from C that S T lies from S. Through N draw D N parallel to C G or S H, which are now parallel to each other, and D N ſhall be an Aſymptote of the Curve deſcribed by the Motion of P.

If in place of a Curve Line B Q M, a fixed Right Line A E be ſubſtituted, then the Point P will deſcribe a Conick Section, whoſe Tangents and Aſymptotes are determined by theſe Conſtructions. In this Supplement, it is afterwards ſhewn how to draw the Tangents and Aſympotes of all the Curves which are deſcribed in the above-mentioned Treatiſe by more Angles and Lines.

III. The ſame Method is afterwards applied for to draw Tangents to Lines deſcribed by other Motions than thoſe which are conſidered in that Treatiſe; of which the following is an Inſtance. Suppoſe that the Lines C P and S P revolve about the Poles C and S, ſo that the Angle A C P bears always the ſame invariable Proportion to A S P, ſuppoſe that of *m* to *n*. In the Line C S, take the Point T, ſo that S T may be to C T in that ſame Proportion of *m* to *n*; and this Point T will be an invariable Point, ſince C T is to C S, as *m* — *n* to *n*. Draw T P, and conſtitute the Angle S P N, equal to C P T, ſo that P N and P T, may lie contrary ways from S P and C P, and P N ſhall be a Tangent of the Curve deſcribed by the Motion of the Point P. Several other Theorems of this kind are ſubjoined here.

Fig. 5



IV. After theſe, Lines or Angles are ſuppoſed to revolve about three or more Poles, and the Dimenſions of the Curves with their Tangents and Aſymptotes are determined. Suppoſe in the firſt Place,

that

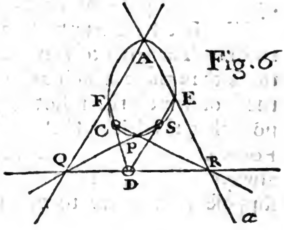


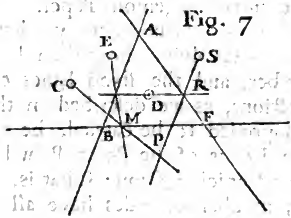
Fig. 6

that the three Poles are C, S and D, and that Lines or Rulers C R, S Q, Q D R, revolve about theſe Poles. The Line which revolves about D, ſerves only to guide the Motion of the other two, ſo that its Interſection with each of them being carried over a fixed Right Line, their Interſection with each other deſcribes the Locus, which is ſhewn to be a Conick Section. The Interſection of Q D R with S Q, is ſuppoſed to be carried over the fixed Right Line A F; the Interſection of the ſame Q D R with C R, is ſuppoſed to be carried over the fixed Right Line A E; and in the mean time, the Interſection of the Right Lines S Q, C R, that revolve about the Poles S and C, deſcribes a Conick Section.

This Conick Section paſſes through the Poles C and S; and if you produce D C and D S, till they meet with A Q and H R in F and E, it will alſo paſs through F and E: It alſo paſſes always through A the Interſection of the fixed Lines Q F and E R; from which this eaſy Method follows for drawing a Conick Section through five given Points. Suppoſe that theſe five given Points are A, F, C, S and E: Join four of them by the Lines A F, F C, A E, E S, and produce two of theſe F C, E S, till they meet, and by their Interſection give the Point D. Suppoſe infinite Right Lines revolve about this

Point D, and the Points C and S, two of thoſe that were given, and let the Interſections of the Line revolving about D, with thoſe that revolve about C and S, be carried over the given Right Lines A E, C F; and the Interſection of thoſe that revolve about C and S with each other, will, in the mean Time, deſcribe a Conick Section, that ſhall paſs through the five given Points A, F, C, S and E.

It is then ſhewn, that when C, S and D are taken in the ſame Right Line, the Point P deſcribes a Right



Line; as alſo when C, S and A are in the ſame Right Line; which alſo follows from what is demonſtrated in that very ingenious Paper concerning *Pappus*'s Poriſms, communicated by Mr. *Sympſon*, Profeſſor of Mathematicks at *Glaſgow* publiſhed in the *Phil. Tranſ.* N°. 377.

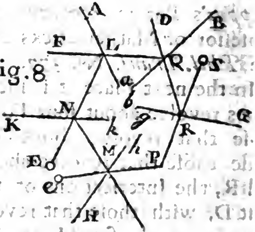
In the next Place it is ſhewn, that if four Right Lines revolve about four Poles C, S, D and E, and thoſe that revolve about D and E, ſerve only to guide thoſe that revolve about C and S; ſo that Q and R, the Interſections of that which revolves about D, with thoſe that revolve about E and S, be carried over the fixed Lines A B and A F; and M the

Interſection of that which revolves about E with that which revolves about C, be carried over a third fixed Line B F, then the Interſection P of thoſe that revolve about C and S, will, in the mean time, deſcribe a Conick Section, and not a Curve of a higher Order. The Conick Section degenerates into Right Lines, when C P and S P coincide at the ſame time with the Line C S, that joins the Poles C and S, as in the preceding Deſcription; which coincides again with what is demonſtrated in the abovementioned ingenious Paper.

After this it is ſhewn generally, that tho' the Poles and Lines revolving about them be increaſed to any Number, and the fixed Lines over which ſuch Interſections, as we deſcribed in the two laſt Caſes, are ſuppoſed to be carried, be equally increaſed, the Locus of the Point P will never be higher than a Conick Section: That is, let a Polygon of any number of Sides have all its Angles, one only excepted, carried over fixed Right Lines, and let each of its Sides produced, paſs through a a given Point or Pole, and that one Angle which we excepted, will either deſcribe a ſtreight Line, or Conick Section.

Thus if a hexagonal Figure L Q R P M N, have all its Angles excepting P carried re-

Fig. 8



ſpectively over the fixed Right Lines A *a*, B *b*, G *g*, H *h*, K *k*, the Point P in the mean time will deſcribe a Conick Section, or a Right Line. The Locus of P is a Right Line when C P and S P coincide together with the Line C S. All theſe things are demonſtrated geometrically.

V. After this, Angles are ſubſtituted in place of Right Lines revolving about theſe Poles; and it is ſtill demonſtrated geometrically, that the Locus of P is a Conick Section or Right Line.

Suppoſe that there are four Poles C, S, D and E, about which the invariable Angles P C Q, P S R, R D M, M E Q revolve; and that Q, M and R, the Interſections of the Legs C Q and E Q, of E M and D M, and of D R and S R, are carried over the fixed Right Lines A *a*, B *b*, and G *g* reſpectively, then the Locus of P is a Conick Section, when C P and S P do not coincide at once with the Line C S, but is a Right Line when C P and S P coincide at the ſame time with C S, and never a Curve of a higher Order.

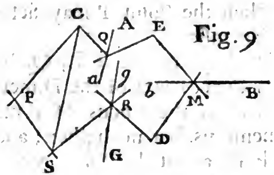
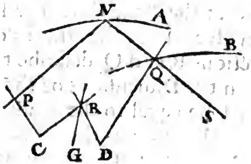


Fig. 9

VI. Having demonſtrated this which ſeems a remarkable Property of the Conick Sections or Lines of the Second Order; I proceed to ſubſtitute Curve Lines in place of Right Lines in theſe Deſcriptions, (as I always do in the Treatiſe concerning the Deſcription of Lines) and to determine the Dimenſions of the Locus of P, and to ſhew how to draw Tangents to it to determine its Aſymptotes, and other Properties of it. I had obſerved in 1719, that by increaſing the Number of Poles and Angles beyond two, the Dimenſions of the Locus of P, did not riſe above thoſe of the Lines of the Second Order, while the Interſections moved on Right Lines; and therefore I did not think it of uſe to me then to take more Poles than two, ſince by taking more, the Deſcriptions became more complex without any Advantage. When the Interſections are carried over Curve Lines, the Dimenſions of the Locus of P riſe higher, but the Curves deſcribed, have *Puncta Duplicia*, or *Multiplicia*, as well as when two Poles only are aſſumed; and therefore this Speculation is more curious than uſeful. However, I ſhall ſubjoin ſome of the Theorems that I found on this Subject concerning the Dimenſions of the Locus of P, and the drawing Tangents to it.

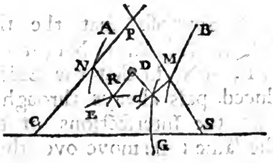
1. If in *Fig.* 6. you ſuppoſe Q and R to be carried over Curve Lines of the Dimenſions m and n reſpectively, then the Point P may deſcribe a Locus of $2\,m\,n$ Dimenſions.

2. If in *Fig.* 8. you ſuppoſe L, Q, R, M, N, to be carried over Curve Lines of the Dimenſions m, n, r, s, t, reſpectively, the Locus of P may ariſe to $2\,m\,n\,r\,s\,t$ Dimenſions, but no higher; and if in place of Lines revolving about the Poles, you uſe invariable Angles, the Dimenſions of the Locus of P will riſe no higher.



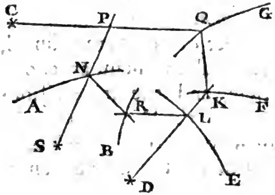
3. I then aſſumed three Poles C, D and S, and ſuppoſed one of the Angles S N L, to have its angular Point N carried over the Curve A N, while the Leg N Q paſſes always through S, as in the Deſcription in the Treatiſe of the General Deſcription of Curve Lines, while the Angles Q D R, R C P, revolve about the Poles D and C: I ſuppoſe alſo the Interſections Q and R to be carried over the Curve Lines B Q, G R, and that the Dimenſions of the curve Lines A N, B Q, G R, are m, n, r, reſpectively; and find that the Locus of P may be of $3mnr$ Dimenſions; but that the Point C is ſuch, that the Curve paſſes through it as often as there are Units in $2nmr$.

4. If any number of Poles are aſſumed, ſo as to have Angles revolving about them, as about C and D in the laſt Article, and the Interſections are carried over other Curves, the Dimenſions of the Locus of P will be equal to the triple Product of the Number of Dimenſions of all the Curves employed in the Deſcription.



5. If the invariable Angles P N R, P M Q, move ſo that while the Sides P N, P M, paſs always through the Poles C and S, the angular

Points N and M deſcribe the Curves A N and BM; and at the ſame time, the invariable Angle R D Q, revolve about the third Pole D, ſo that the Interſections R and Q deſcribe the Curves E R and G Q; then the Dimenſions of the Locus of P, when higheſt, ſhall be equal to the quadruple Product of the Numbers that expreſs the Dimenſions of the given Curves A N, E R, G Q and B M, multiplied continually into each other. If more Poles are aſſumed, about which Angles be ſuppoſed to move, as R D Q moves about D in this Deſcription, and the Interſections of the Sides be ſtill carried over Curves, as in this Example; the Dimenſions, of the Locus of P, when higheſt, ſhall ſtill be found equal to the quadruple Product of all the Numbers that expreſs the Dimenſions of the Curves employed in this Deſcription.



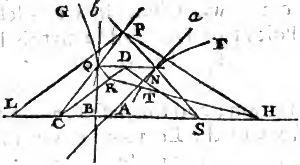
6. Suppoſe that the three invariable Angles P Q K, K L R, R N P, move over the Curves G Q, E L, A N, ſo that the Sides P Q, K L, P N produced, paſs always through the Poles C, D, S, and that the Interſections of their Sides K and R, at the ſame time move over the Curves F K and B R;

and the Dimenſions of the Locus of P when higheſt, ſhall be equal to the Product of the Numbers that expreſs the Dimenſions of the given Curves multiplied by Six. If more Poles, with the neceſſary Angles and Curves, are aſſumed betwixt C and D, as here D is aſſumed betwixt C and S, and the Motions be in other reſpects like to what they are in this Example; then in order to find the Dimenſions of the Locus of P when higheſt, raiſe the Number 2 to a Power whoſe Index is leſs than the Number of Poles by a Unit; add 2 to this Power, and multiply the Sum by the Product of the Numbers that expreſs the Dimenſions of the Curves employed in the Deſcription; and this laſt Product ſhall ſhew the Dimenſions of the Locus of P when higheſt.

I am able to continue theſe Theorems much farther: But it is not worth while, eſpecially ſince I find that there is not any conſiderable Advantage obtained by increaſing the number of Poles above the Method delivered in the abovementioned Treatiſe of the Deſcription of Curve Lines. On the contrary, the Deſcriptions there given by means of two Poles, will produce a Locus of higher Dimenſions by the ſame number of Curves and Angles, than theſe that require three or more Poles; and are therefore preferable, unleſs perhaps in ſome particular Caſes.

VII. However, I have alſo found how to draw Tangents to the Curves that ariſe in all theſe Deſcriptions; of which I ſhall give one Inſtance where three Right Lines are ſuppoſed to revolve about three Poles, and two of their Interſections are ſuppoſed to be carried over given Curve Lines, and the third deſcribes the Locus required.

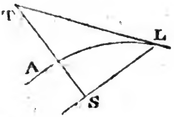
Let the Right Lines C Q, S N, D N, revolve about the Poles C, S, D, where that which revolves about D, ſerves to guide the Motion of the other two; its Interſection with C Q moving over the Curve G Q, while its Interſection with S N moves over the Curve F N. Suppoſe that the Right Line B *b* touches the Curve G Q in Q, and that the Right Line A *a* touches the Curve F N in N. In order to draw a Tangent to the Locus of P; join D C, D S and C S, and conſtitute the Angle D Q R, equal to C Q B, ſo that Q R lie the contrary way from Q D that Q B lies from Q C, and let Q R meet D C in R. Conſtitute alſo the Angle D N T, equal to S N A with the like precaution, and let N T meet D S in T. Join R T, and produce it till it meet C S in H; then join P H, and make the Angle C P L equal to S P H, ſo that P L and P H, may lie contrary ways from C P and S P; and P L ſhall be a Tangent at P, to the Locus deſcribed by P, the Interſection of C Q and S N.



I have alſo applied this Doctrine to the Deſcription of Lines through given Points. But I ſuppoſe I have ſaid enough at preſent on this Subject; and ſhall conclude, after obſerving that in the abovementioned Treatiſe, I have given an eaſy Theorem for calculating the Reſiſtance of the Medium when a given Curve is deſcribed with a given centripetal Force in a reſiſting Medium, which I ſhall here repeat, becauſe it has been miſrepreſented in a foreign Journal.

Let V expreſs the centripetal Force with which the Body that is ſuppoſed to deſcribe the Curve, is acted on in the Medium; let v expreſs the centripetal Force with which the ſame Curve could be deſcribed in a Void; ſuppoſe $z = \frac{V}{v}$, and the Reſiſtance ſhall be proportional to the Fluxion of z multiplied by the Fluxion of the Curve, ſuppoſing the Area deſcribed by a Ray, drawn from the Body to the Center of the Forces, to flow uniformly. Let this Theorem be compared with what the celebrated Mathematician mentioned by that Journaliſt has given on the ſame Subject, and it will eaſily appear what judgment is to be made of his Aſſertion; and ſince ſeveral Perſons, and particularly the Gentleman mentioned above in this Paper, teſtify that I communicated to them this Theorem before any Thing was publiſhed on this Subject by the learned Mathematician he names, his Obſervation on this Occaſion muſt appear the more groundleſs.

From this Theorem, I draw this very general Corollary, that if the Curve is ſuch as could be deſcribed in a Void by a centripetal Force, varying according to any Power of the Diſtance, then the Denſity of the Medium in any place, is reciprocally proportional to the Tangent of the Curve at that place, bounded at one Extremity by the Point of Contact, and, at the other, by its Interſection with a Perpendicular raiſed at the Center of the Forces to the Ray drawn from that Center to the Point of Contact. Let A L be the Curve deſcribed by a Force directed to the Point S; let L T touch the Curve at L, and raiſe S T perpendicular to S L, meeting L T in T, and the Denſity in L ſhall be univerſely as L T, if the Reſiſtance be ſuppoſed to obſerve the compound Proportion of the Denſity, and of the Square of the Velocity.



Beſides what I have obſerved here, I propoſe to illuſtrate and improve ſeveral other Parts of the Treatiſe concerning the Deſcription of Curve Lines in this Supplement.

That Treatiſe requires theſe Additions and Illuſtrations the more, that tho' the whole almoſt was new, it was publiſhed in a hurry, when I was very young, before I had time to conſider ſufficiently which were the beſt ways of demonſtrating the Theorems, or reſolving the Problems, for which this Supplement I hope, will make ſome Apology.

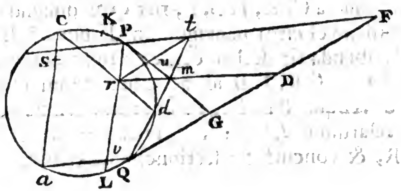
N. B. *The following Paper, dated at* Nancy, Novem. 27, 1722, *is that which the Author mentions in his Letter.*

SECTIO

SECTIO I.

Prop. 1. *Quæ reſpicit deſcriptionem Linearum* 1.

Circa Polos C, B, D, moveantur rectæ C *d*, B *m*, D *r*, & ducatur concurſus crurum B *m*, D *r* per rectam datam P G, concurſus crurum C *d*, D *r* per rectam F Q etiam datam & concurſus crurum C *d*, B *d* ſectionem conicam deſcribet.

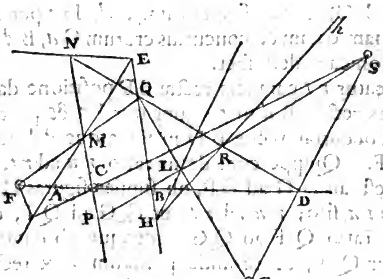


Ducatur *r t* parallela rectæ B D poſitione datæ occurrens rectæ B *d* in *t*; jungatur P *t* & producatur donec occurrat rectæ B D in F; atque dabitur punctum F. Quippe cum detur ratio *r u* ad *r t*, eadem enim eſt ac D G ad D B, ob ſimiles figuras D *m* B G & *r m t a* ſitq; *r u* ad *r t*, ut Q G ad Q F, dabitur etiam ratio Q F ad Q G; adeoque ob datam Q G dabitur Q F, & proinde punctum F & recta P F. Cum igitur B *t* & C *r* partes abſcindant P *t*, P *r*, à rectis poſitione datis P F, P Q, in data ſemper ratione erit illarum concurſus *d* in ſectione conica per Lemma 20. Lib. 1. Princip. D. Neutoni.

Si punctum D ſumatur ubicunque in recta B F, ſitque ſemper D G ad Q G ut B D ad Q F, eadem erit ſectio conica quam *d* deſcribet.

Sectio conica tranſit per C, P, B & *a* complendo parallelogrammum, P S *a* Q. Tranſit etiam per L ubi recta B G producta occurrit ipſi P *q*, ut etiam per K ubi recta C D ſecat datam P G. Unde pentagonum P K C L B ſectioni inſcribitur. Et ſi detur quinque puncta C, K, P, B, L, per quæ ducenda eſt ſectio conica vel circa pentagonum datum C L B P K circumſcribenda ſit ſectio conica producantur duo quævis latera C K, L B ad occurſum ſuum D dein jungantur reliqua P L, P K & ducantur ſemper concurſus rectarum C *d*, D *r*; B *d*, D R per rectas illas P L, P R, & concurſus *d* ſectionem deſcribet.

P R O P. II.



Circa data puncta F, C, G S, ut Polos moveantur, rectæ F Q, C N, G Q, S L & concurſus rectarum

FQ & CN, FQ & GQ, GQ & SL, puncta ſcil. M, Q, L, ſemper contingant rectas poſitione datas AE, BE, HL; & concurſus rectarum CN, SL deſcribet ſectionem conicam.

Occurrant rectæ AM, HR ipſi BQ in E & H Jungantur CF & GS quæ ſibi mutuo occurrunt in D, jungatur DQ quæ occurrat rectis CM, SL in N & R; & ſi jungantur EN, & HR, erunt EN & HR, rectæ poſitione datæ per Lemma 1. Quippe cum ſint puncta F, C, D, in eadem recta Linea & concurſus rectarum FM, CM & FQ, DQ percurrant datas rectas, concurſus crurum CM, DQ, etiam continget datam. Et ſimili ratione cum ſint S, D, G in eadem recta concurſus rectarum DQ, SL etiam continget datam.

Omiſſis igitur Polis F & G, invenienda eſt curva quam concurſus rectarum CN, SL, viz. P deſcribet dum rectis CN, DN, SR revolventibus circa Polos C, D, S concurſus rectarum CN, DN contingit datam EN & concurſus rectarum SR, DN contingit datam HR, eam vero ſectionem eſſe conicam ex Prop. præcedenti eſt manifeſtum.

N. B. *The Papers referred to were publiſhed in a little Treatiſe entituled,* Exercitatio Geometrica de deſcriptione Curvarum. *Londin.* 1733. *4to.*

VI. *A Letter from* Stephen Gray, *F. R.* S. *to Dr.* Mortimer, *Secr. R. S. containing ſome* Experiments *relating to* Electricity.

THE following Lines contain an account of what Electrical Experiments I have made ſince thoſe I laſt communicated to the Society which was in *February* laſt.

February the 18th, I tried what Effect would be produced on ſeveral Sorts of Wood with reſpect to the luminous Part of Electricity: the Wood was made into Rods of the ſame Form with thoſe Iron Ones mentioned in my former Letter upon this Subject; the Woods made uſe of were Fir, Aſh and Holly; theſe being ſucceſſively diſpoſed upon Electrick Bodies, after the ſame manner as the Iron Rods had been, the Tube being applied to one End, there appeared a Light on it, but not with ſo great a Force, nor did the Light extend to ſo great a length; neither was the Form of it Conical, but rather Cylindrical; but the Extremity of it ſeemed to conſiſt of a ſhort Fringe of Light; when the Light, that was given to the Rod by the application of the Tube, did ceaſe, upon a motion of my Hand towards the Point of the Rod, the Light came out again, as has been mentioned of the Iron Rods; but when the Hand or Finger was held near the Point of theſe wooden Rods, there was no pricking or puſhing of the Finger felt, as when the Iron Rods were made uſe of. I had ſome of theſe Rods made much bigger at one End than the other, and now applying my Finger to the larger End, there not only appeared a Light, but the Finger was puſhed, more eſpecially when the Holly Rod was made uſe of, and the Cheak was a little prick'd, but the Smart was not near ſo great, as when the Iron Rods were uſed; the great End of the Rod was pointed with a much larger Angle then the leſſer one, yet there was very little, if any difference, in the form, or bigneſs of the Light that proceeded from either End.

Having procured me two pair of Lines made of Worſted Yarn, one of them of a Mazareen Blew, the other of a Scarlet Colour; on the 3d of *April*, I ſuſpended the Boy firſt on the Blew Lines, and found that all the Effects were the ſame, as when he was ſuſpended on Lines of Blew Silk. I then ſuſpended him upon the Scarlet Lines, but now though the Tube were as well excited, and the Experiment often repeated, yet there was no Effect produced on him, either of attraction of a pendulous Thread, nor of pricking or burning, by applying one's Hand near him; I then laid one of the Iron Rods firſt upon the Blew Lines, and all the ſame Effects were exhibited, as when the ſame Rod had been laid on Silk Lines of that Colour; but upon laying the ſame Rod upon the Scarlet Lines, no manner of attraction, *&c.* was perceived.

In the Philoſophical Tranſactions, *Numb.* 422. I gave an Account of the Experiments I made upon the communicative Electricity of Water, and that Water is attracted by the Tube, together with ſeveral remarkable Circumſtances with which this attraction is attended; but I have now found, that when the Stand with thoſe little Ivory Cups there mentioned, be ſet upon any Electrick Body, the ſame Phænomena are produced, not only by holding the Tube near the Water, but when that is removed, and the Tip of the Finger placed over the Water, *viz.* there is a little Hill, or Protuberance of Water of a Conical Form, from the Vertex of which proceeded a Light and a ſmall Snapping.

May the 6th, we made the following Experiment. The Boy being ſuſpended on the Silk Lines, and the Tube being applied near his Feet as uſual; upon his holding the End of his Finger near a Gentleman's Hand, that ſtood on a Cake made of Shell Lack and black Roſin; at the ſame time another Gentleman ſtood at the other ſide of the Boy with the pendulous Thread; then the Boy was bid to hold his Finger near the firſt Gentleman's Hand, upon which it was prick'd, and the ſnapping Noiſe was heard; and at the ſame time, the Thread which was by its attraction going towards the Boy fell back, the Boy having loſt a great part of his attraction, upon a ſecond moving his Finger to the Gentleman's Hand, the attraction ceaſed: then the Thread being held near that Gentleman, he was found to attract very ſtrongly; but having ſince repeated this Experiment, I find that though the attraction of the Boy is much diminiſhed, yet he does not quite loſe it, till 2, 3, and ſometimes 4 applications of his Finger to the hand of him that ſtands on the Electrick Body, but without touching him. At another time I cauſed three Perſons to ſtand, one of them upon a Cake of Shell Lack, *&c.* the other upon one of Sulphur, the third upon a Cake of Bees-Wax and Roſin; the Perſons all holding Hands, the Boy applying his

Finger near the firſt Man's Hand, they all three became Electrical, as appeared by the attraction of the Thread, when held near to any of them.

POSTSCRIPT.

A Repetition *of ſome of theſe* Experiments, *and an Addition of ſome others made* June *the* 10*th*.

June the 10th in the Morning, I repeated the Experiments with the Wooden Rods, the moſt material Ones of which were made with the Holly Rod: This being laid on the Glaſs Cylinder, and a Fir Board about a Foot Square and three tenths of an Inch thick being placed erect upon a Stand, that was ſet on another Glaſs Cylinder, ſo that the Center of the Board was placed near the Point of the Rod, but not to touch it by near half an Inch; then the Tube being held near the great End of the Rod, there iſſued out a Light from the little End of the Rod, which was that next the Board; and, as the Boy told me, it came along with a hiſſing Noiſe, and ſtruck againſt the Board: When he touched the Board, there was a Light; and, at the ſame time, another on the End of the Rod, but he heard no ſnapping nor pricking of his Finger, as when the Braſs Plate and Iron Rod were made uſe of.

Experiments with the Scarlet *and* Blue *Worſted Yarn repeated.*

When the Boy was ſuſpended upon the Scarlet Lines, he attracted the white Thread at a very ſmall Diſtance, but the Attraction ceaſed in about 6 or 7 Seconds of Time. Then the Boy being taken off, an Iron Rod was laid on the Lines, but there was no attraction of the Thread by the Body of the Rod ; but when the Thread was held near either of the pointed Ends of it, there was a ſmall Repulſion of it, and in the Dark a very ſmall Light was ſeen at each End of the Rod.

When the Boy was ſuſpended upon the Blue Lines, he attracted the Thread to him when it was held at leaſt a Foot diſtance from him, and continued his attraction to near 75 Seconds, the Iron Rod continued its attraction not more than 36 Seconds.

Experiments made in the Afternoon upon the Boy when he was ſuſpended upon Silk Lines of ſeveral Colours.

When he was ſuſpended on the Blue Lines, he continued his Attraction 50 Minutes, on the Scarlet Lines 25 Minutes, on the Orange coloured Lines 21 Minutes.

By theſe Experiments we ſee the Efficacy of Electricity upon Bodies ſuſpended upon Lines of the ſame Subſtance, but of different Colours, and alſo that the Attraction continues much longer upon Silk than upon Yarn, and conſequently Silk is the propereſt Body we can make uſe of to ſuſpend thoſe Bodies upon, to which we would communicate an Electricity : But of this Subject more when I ſhall reaſſume the Experiments concerning the Influence of Colours upon Electricity; who am,

S I R,

Charter Houſe,
June 12, 1735.

Your's and the Society's moſt
Humble and obedient Servant,

Stephen Gray.

VII. *An Account of the* Births *and* Burials *with the* Number of the Inhabitants *at* Stoke-Damerell *in the County of* Devon. *Communicated by the Reverend Mr.* Barrow.

SEveral Accounts of Births and Burials having been publiſhed for the Satisfaction of the Curious; the following, which in one Reſpect (the Number of Inhabitants) is more particular than moſt I have ſeen, will, I hope, be acceptable to the Publick.

A Survey being taken about *Michaelmas* 1733, of the Inhabitants of *Stoke-Damerell* in the County of *Devon*, the Number of Perſons, Men, Women, and Children, reſiding in the Pariſh, amounted to 3361. By the Regiſter, I find that in the ſame Year, 28 Couple were married, 61 Males and 61 Females baptized, and 62 People buried.

Bapized.	*Buried.*	*Number of People.*
122.	62.	3361.

Whence it appears that the Number of Perſons who died, is one more than half the Number of Children born; and that about 1 in 54 died.

It is to be obſerved, that the General Fever, which almoſt all the Inhabitants of the ſame Place were ill of at the ſame time, was in part within the Year mentioned: alſo that one of the Perſons included in the Number of thoſe buried, was a Foreigner brought from on board a *Dutch* Ship in the River; and that 2 more were drowned from on board a Man of War; but the Ships Companies are not included in the Number of the Inhabitants.

Not from this Account only, but from Experience and Obſervations, both of my ſelf and better Judges, I reckon the Pariſh of *Stoke-Damerell* as healthful an Air as any in *England.*

VIII. *An Extraordinary Caſe of the* Foramen Ovale *of the Heart, being found open in an Adult, communicated by* Claudius Amyand, *Eſq*; Serjeant *Surgeon to his* Majeſty, *and F. R. S.*

MR.* dying at the Age of Twenty-two, of an Illneſs that had perplexed his Phyſicians, was opened, to diſcover an Impoſthume, which was apprehended in the Belly. As nothing was obſerved there worth notice, ſaving a very great Relaxation of the *Viſcera*, the Cauſe of his Death was looked for in the *Thorax*; there the Lungs were ſtrongly attached to the *Pleura* on each Side, and a large Collection of Water in each Cavity, eſpecially on the Left, where the poſterior Lobe was inflamed, and tending to Suppuration; the Quantity of Water in the *Pericardium* was greater than uſual, and the Heart much larger than could be expected in ſo great an Atrophy as the Patient was reduced to; in it the *Foramen Ovale* was found open, ſo as to give paſſage to a large Finger, when a fungous Subſtance, which grew from the Circumference of the *Foramen*, and did ſtop up the ſame, was removed. The Valve was hardly perceptible, it being callous and furled up. The *Ductus Arterioſus* was found cloſe as uſual. This Patient had enjoyed great Health till lately, and had given no ſign of this opening of the *Foramen Ovale*, which is præternatural in Adults.

ERRATA: Pag. 146. l. 21. r. Duplicia. Pag. 165. *dele* N. B. &c. *all the 4 lines at the bottom.*

N° 110

Transact. N° 440.

Numb. 440.

PHILOSOPHICAL TRANSACTIONS

For the Months of *January*, *Febr.* and *March*, 1736.

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II. *The apparent Times of the Immerſions and Emerſions of* Jupiter's Satellites, *which will happen in the Year* 1737. *Computed to the Meridian of the* Royal Obſervatory *at* Greenwich, *by* James Hodgſon, *F. R. S. and Maſter of the* Royal Mathematical School *in* Chriſt-Hoſpital, London.

III. *The apparent Times of ſuch of the* Immerſions *and* Emerſions *of* Jupiter'*s Satellites, as are viſible at* London *in the Year* 1737. *By* James Hodgſon, *F. R. S.*

IV. *A Propoſition relating to the Combination of* Tranſparent Lens's *with* Reflecting Planes. *By* J. Hadley, *Eſq; V. Pr. R. S. Communicated to the* Royal Society, January 9, 1734.

V. *An*

V. *An Account of a large* Bony Subſtance *found in the* Womb, *which was ſhewn to the* Royal Society, May *the* 17*th*, 1733, *by* Edward Hody, *M. D. F. R. S.*

VI. *Some Experiments concerning the* Impregnation *of the* Seeds *of* Plants, *by* James Logan, *Eſq*; *Communicated in a Letter from him to Mr.* Peter Collinſon, *F. R. S.*

VII. *Some* Obſervations *of Eclipſes of* Jupiter's Satellites, *made by* Geo. Lynn, *Eſq*; *at* Southwick, *near* Oundle *in* Northamptonſhire ; *Communicated in a Letter to* James Jurin, *M. D. F. R. S. and Fellow of the* Royal College *of* Phyſicians, London.

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IX. Affectus Cutaneus ſingularis, *ab* Abrahamo Vatero, *Anatomes & Botanices in Academia* Wittembergenſi *Profeſſore publico, R. S. S.* Regali Societati *communicatus.*

X. Experiments *concerning the* Vibrations *of* Pendulums. *By the late* W. Derham, *D. D.* F. *R.* S. *and Canon of* Windſor.

XI. *The* Conſtruction *and* Uſe *of* Spherical Maps, *or ſuch as are delineated upon Portions of a* Spherical Surface. *By Mr.* John Colſon, M. A. *F. R. S.*

I. *A Catalogue of the* Fifty Plants *from* Chelſea Garden, *preſented to the* Royal Society *by the Company of* Apothecaries, *for the Year* 1734, *purſuant to the Direction of Sir* Hans Sloane, *Bar*^{t}. *Med. Reg. Præſ. Col. Reg. Med. & Soc. Reg. By* Iſaac Rand, *Apothecary, F. R. S. Hort. Chel. Præſ. ac Prælec. Botan.*

601. ABSINTHIUM inſipidum, Abſinthio vulgari ſimile. C. B. 139.

602. Abſinthium maritimum album. Ger. Emac. 940.
Abſinthium Romanum Offic. Lond. ramulis expanſis.

603. Abſinthium maritimum; ramulis & capitulis erectis.

604. Abſinthium maritimum, fruticoſius; ramulis erectis; tenuiſſime diviſis foliis.

605. Apium dulce; radice Rapacea. D. Juſſieu.

606. Apium Macedonicum. C. B. 154.
Petroſelinum Macedonicum. Officin.

607. Apium Pyrenaicum, Thapſiæ facie. T. Inſt. 305.

608. Apium Thapſiæ facie, majus & elatius.
Apium Petræum ſive montanum album. I. B. Pariſienſium.

609. Apium, Thapſiæ facie, medium.

610. Aſclepias albo flore. C. B. Pin. 303.

Aſclepias, ſive Vincetoxicum multis, *floribus albicantibus*. I. B. 2. 138. *Vincetoxicum* Dod. Pempt. 407.

611. Aſclepias Anguſtifolia flore flaveſcente. H. R. Par.

612. Aſter ramoſus, annuus Canadenſis. Tourn. Inſt. 482.

613. Aſter annuus, foliis variis, flore amplo peramoenè purpureo.

Kiang-ſita Sinenſis, D. Juſſieu. *Aſter Chenopodii folio annuus ; flore ingenti ſpecioſo.* Hort. Elt. Tab. XXXIV.

614. Aſter Americanus, latiſſimo aurito & ſerrato folio ; floribus albidis umbellatim diſpoſitis. An *Aſter Canadenſis foliis imis amplioribus cordatis & ſerratis ?* D. Sarrazin. Ac. Reg. Par. 1720.

615. Aſter Americanus præcox, anguſtifolius ; parvo albente flore.

616. Aſter Novæ Angliæ, Linariæ foliis ; Chamæmeli floribus. Par. Bat. 96.

617. Aſter Virginianus, latifolius præcocior ; purpuraſcente parvo flore. Park. Theat.

Aſteriſcus latifolius autumnalis. Cornut. 64.

618. Cnicus cæruleus, humilis, Montis Lupi. H. L. Bat.

619. Eruca Tanaceti folio. H. Reg. Par.

620. Fagopyrum Americanum anguſtifolium, procumbens ; caulibus Lappaceis.

621. Fagopyrum vulgare ſcandens. T. Inſt. 511.

622. Geniſta tinctoria. Ger. Emac. 1136.

623. Geniſta tinctoria maxima Auſtriaca. D. Boerhaave.

624. Granadilla flore albo, fructu reticulato. Boerh. Ind. 82.

625. Granadilla oblongo acuminato folio, flore purpureo.

An *Granadilla folio oblongo ſerrato, flore purpureo.* D. Houſton ?

626. Lapathum Ægyptiacum annuum; Parietariæ folio; capſula ſeminis longius barbata. H. Piſan.

627. Lapathum aquaticum; folio cubitali. C. B. 116.

628. Lapathum hortenſe, rotundifolium ſive montanum. C. B. 115.

629. Lapathum rotundifolium, maximum. q. *Rhaponticum* Officin.

630. Lapathum ſativum. Dod. 618. q. *Patientia* Officin.

631. Medicago annua Trifolii facie. T. Inſt. p. 412.

632. Medicago maritima trifolia annua polycarpos; fructu toroſo non ſpinoſo. D. Micheli, Hort. Piſ. p. 110.

633. Perſicaria perennis repens latifolia.

634. Pulegium anguſtifolium. C. B 222.
Pulegium Cervinum. Offic.

635. Pulegium anguſtifolium flore albo. H. Reg. Par. *Planta eſt præcedente fere triplo major.*

636. Pulegium latifolium. C. B. 222.

637. Pulegium latifolium erectum.

638. Scorpioides; Bupleuri folio. C. B. Pin. 287.

639. Scorpioides ſiliqua craſſa. Boerh. Ger. Emac. App. 1627.

640. Scorpioides ſiliqua ſtriata, minus aſpera.

641. Scrophularia flore luteo. C. B. 236.

642. Scrophularia folio Urticæ. C. B. 236.
Scrophularia peregrina. Cam. Hort. Icon. 43.

643. Scrophularia Lamii folio. D. Bobart.

644. Scrophularia nemorenſis; folio Urticæ rugoſo; flore atro-punicante. H. C. Boerh. Ind. Alt. 234.

645. Scrophularia Orientalis foliis Cannabinis. T. Cor. 9.

646. Scrophularia Sexatilis, lucida, Laſerpitii Maſſilienſis foliis. Boc. Muſ. 166.

647. Scrophularia Scorodoniæ folio. Mor. Hiſt. Ox. 482.

648. Tragopogon Gramineo folio; ſuaverubente flore. Col. 231.

649. Tragopogon luteum, foliis gramineis; caule purpuraſcente. Boerh. Ind. Alt. p. 90.

650. Xeranthemum flore ſimplici purpureo minore. T. Inſt. 499.

II. *The*

II. *The apparent Times of the Immerſions and Emerſions of* Jupiter's Satellites, *which will happen in the Year* 1737. *Computed to the Meridian of the* Royal Obſervatory *at* Greenwich, *by* James Hodgſon, *F. R. S. and Maſter of the* Royal Mathematical School *in* Chriſt-Hoſpital, London.

The apparent Times of the ECLIPSES *of the Firſt Satellite of* JUPITER.

D.	H.	M.	
	JANUARY.		
	Emerſions.		
1	8	23	A
3	2	51	A
5	9	19	M
7	3	47	M
8	10	15	A
10	4	44	A
12	11	12	M
14	5	40	M
17	6	37	A
19	1	5	A
	FEBRUARY.		
	Immerſions.		
25	3	54	A
27	9	23	M

D.	H.	M.	
	MARCH.		
	Immerſions.		
1	3	53	M
2	10	22	A
4	4	51	A
6	11	20	M
8	5	49	M
9	11	18	A
11	6	47	A
13	1	17	A
15	7	46	M
17	2	15	M
18	8	44	A
20	3	13	A
22	9	42	M
24	14	11	M
25	10	41	A
27	5	6	A
29	11	39	M
31	6	8	M

D.	H.	M.	
	APRIL.		
	Immerſions.		
2	0	37	M
3	7	6	A
5	1	35	A
7	8	4	M
9	2	33	M
10	9	2	A
12	3	31	A
14	10	0	M
16	4	28	M
17	10	58	A
19	5	26	A
21	11	55	M
23	6	24	M
25	0	52	M
26	7	21	A
28	1	50	A
30	8	18	M

MAY

The apparent Times of the ECLIPSES *of the firſt Satellite of* JUPITER.

MAY.

Immerſions.

D.	H.	M.	
2	2	47	M
3	9	15	A
5	3	44	A
7	10	12	M
9	4	45	M
10	11	9	A
12	5	38	A
14	0	6	A
16	6	34	M
18	1	1	M
19	7	31	A
21	1	59	A
23	8	27	M
25	2	56	M
26	9	24	A
28	3	52	A
30	10	20	M

JUNE.

Immerſions.

D.	H.	M.	
1	4	48	M
2	11	17	A
4	5	46	A
6	0	13	A
8	6	41	M
10	1	9	M
11	7	36	A
13	2	5	A
15	8	34	M
17	3	2	M
18	9	30	A
20	3	58	A
22	10	26	M
24	4	55	M
25	11	23	A
27	5	51	A
29	0	19	A

JULY.

Immerſions.

D.	H.	M.	
1	6	48	M
3	1	16	M
4	7	44	A
6	2	13	A
8	8	41	M
10	3	9	M
11	9	38	A
13	4	6	A
15	10	35	M
17	5	4	M
18	11	32	A
20	6	1	A
22	0	29	A
24	6	58	M
26	1	27	M
27	7	56	A
29	2	25	A
31	8	53	M

AUGUST.

Immerſions.

M.	H.	D.	
2	3	22	M
3	9	51	A
5	4	20	A
7	10	49	M
9	5	18	M
10	11	47	A
12	6	16	A
14	0	45	A
16	7	15	M
18	1	44	M
19	8	13	A
21	2	42	A
23	9	11	M
25	3	41	M
26	10	10	A
28	4	39	A
30	11	7	M

SEPTEMBER.

Emerſions.

M.	H.	D.	
1	7	51	M
3	2	21	M
4	8	50	A
6	3	19	A
8	9	49	M
10	4	18	M

The apparent Times of the ECLIPSES *of the firſt Satellite of* JUPITER.

D.	H.	M.	
SEPTEMBER.			
Emerſions.			
11	10	47	A
13	5	17	A
15	11	46	M
17	6	15	M
19	0	43	M
20	7	14	A
22	1	43	A
24	8	13	M
26	2	43	M
27	9	11	A
29	3	40	A
OCTOBER.			
Emerſions.			
1	10	10	M
3	4	39	M
4	11	8	A
6	5	37	A
8	0	6	A
10	6	35	M
12	1	5	M
13	7	34	A
15	2	3	A
17	8	31	M
19	3	0	M
20	9	29	A
22	3	58	A
24	10	27	M
26	4	56	M
27	11	25	A
29	5	53	A
31	0	22	A
NOVEMBER.			
Emerſions.			
2	6	51	M
4	1	19	M
5	7	48	A
7	2	16	A
9	8	45	M
11	3	13	M
12	9	42	A
14	4	10	A
16	10	38	M
18	5	26	M
19	11	35	A
21	6	3	A
23	0	31	A
25	6	59	M
27	1	27	M
28	7	55	A
30	2	23	A
DECEMBER.			
Emerſions.			
2	8	51	M
4	3	19	M
5	9	47	A
7	4	16	A
9	10	44	M
11	5	12	M
12	11	40	A
14	6	8	A
16	0	35	A
19	7	3	M
20	1	31	M
21	7	59	A
23	2	28	A
25	8	56	M
27	3	24	M
28	9	52	A
30	4	20	A

The

The apparent Times of the ECLIPSES *of the ſecond Satellite of* JUPITER.

D.	H.	M.	
	JANUARY.		
	Emerſions.		
4	0	3	A
8	1	20	M
11	2	38	A
15	3	55	M
18	5	13	A
	FEBRUARY.		
	Immerſions.		
26	4	44	A
	MARCH.		
	Immerſions.		
2	6	3	M
5	7	23	A
9	8	42	M
12	10	1	A
14	11	20	M
20	0	39	M
23	1	59	A
27	3	18	M
30	4	37	A

D.	H.	M.	
	APRIL.		
	Immerſions.		
3	5	56	M
6	7	15	A
10	8	33	M
13	9	52	A
17	11	11	M
21	0	29	M
24	1	48	A
28	3	6	M
	MAY.		
	Immerſions.		
1	4	24	A
5	5	42	M
8	7	0	A
12	8	18	M
15	9	35	A
19	10	53	M
23	0	12	M
26	1	27	A
30	2	45	M
	JUNE.		
	Immerſions.		
2	4	2	A
6	5	19	M

D.	A.	M.	
9	6	36	A
13	7	54	M
16	9	11	A
20	10	28	M
23	11	46	A
27	1	3	A
	JULY.		
	Immerſions.		
1	2	20	M
4	3	38	A
8	4	56	M
11	6	13	A
15	7	31	M
18	8	50	A
22	10	8	M
25	11	26	A
29	0	45	A
	AUGUST.		
	Immerſions.		
2	2	3	M
5	3	22	A
9	4	41	M
12	6	0	A
16	7	19	M
19	8	33	A
23	9	58	M
26	11	17	A
30	1	37	A

SEPTEM-

The apparent Times of the ECLIPSES *of the ſecond Satellite of* JUPITER.

SEPTEMBER.

Emerſions.

D.	H.	M.	
3	4	43	M
6	6	2	A
10	7	22	M
13	8	41	A
17	10	1	M
20	11	20	A
24	0	40	A
28	1	59	M

OCTOBER.

Emerſions.

D.	H.	M.	
1	3	19	A
5	4	38	M
8	5	57	A
12	7	16	M
15	8	35	A
19	9	54	M
22	11	12	A
26	0	31	A
30	1	49	M

NOVEMBER.

Emerſions.

D.	H.	M.	
2	3	7	A
6	4	25	M
9	5	46	A
13	7	1	M
16	8	18	A
20	9	35	M
23	10	53	A
27	0	10	A

DECEMBER.

Emerſions.

D.	H.	M.	
1	1	27	M
4	2	44	A
8	4	1	M
11	5	17	A
15	6	34	M
18	7	51	A
22	9	8	M
25	10	25	A
29	11	42	M

The apparent Times of the ECLIPSES *of the third Satellite of* JUPITER.

JANUARY.

Emerſions.

D.	H.	M.	
8	2	13	M
15	6	1	M

FEBRUARY.

Immerſions.

D.	H.	M.	
27	2	42	M

MARCH.

Immerſions.

D.	H.	M.	
6	6	45	M
13	10	48	M
20	2	51	A
27	6	54	A

The apparent Times of the ECLIPSES *of the third Satellite of* JUPITER.

ARRIL.

Immerſions.

D.	H.	M.	
3	10	57	A
11	2	59	M
18	7	1	M
25	3	11	M

Emerſions.

D.	H.	M.	
4	2	21	M
11	6	23	M
18	10	24	M
25	2	25	A

MAY.

Immerſions.

D.	H.	M.	
2	3	4	A
9	7	5	A
16	11	5	A
24	3	4	M
31	7	4	M

Emerſions.

D.	H.	M.	
2	6	25	A
9	10	25	A
17	2	25	A
24	6	24	M
31	10	22	M

JUNE.

Immerſions.

D.	H.	M.	
7	11	3	M
14	3	3	A
21	7	2	A
28	11	1	A

Emerſions.

D.	H.	M.	
7	2	21	A
14	6	19	A
21	10	18	A
29	2	17	M

JULY.

Immerſions.

D.	H.	M.	
6	3	1	M
13	7	2	M
20	11	3	M
27	3	5	A

Emerſions.

D.	H.	M.	
6	16	16	M
13	10	16	M
20	2	16	A
27	6	17	A

AUGUST.

Immerſions.

D.	H.	M.	
3	7	7	A
10	11	10	A
18	3	13	M
25	7	17	M

SEPTEMBER.

Emerſions.

D.	H.	M.	
1	2	29	A
8	6	32	A
15	10	36	A
23	2	39	M
30	6	42	M

OCTOBER.

Immerſions.

D.	H.	M.	
7	7	41	M
14	11	45	M
21	3	47	A
28	7	49	A

Emerſions.

D.	H.	M.	
7	10	45	M
14	2	47	A
21	6	49	A
28	10	50	A

NOVEM-

The apparent Times of the ECLIPSES *of the third Satellite of* JUPITER.

D.	H.	M.	
NOVEMBER.			
Immerſions.			
4	11	51	A
12	3	52	M
19	7	52	M
25	11	52	M
Emerſions.			
5	2	51	M
12	6	51	M
19	10	50	M
26	2	49	A
DECEMBER.			
Immerſions.			
3	3	51	A
10	7	50	A
17	11	49	A
25	3	48	M
Emerſions.			
3	6	47	A
10	10	45	A
18	2	43	M
25	6	41	M

The apparent Times of the ECLIPSES *of the fourth Satellite of* JUPITER.

JANUARY.			
Immerſions.			
14	7	41	A
Emerſions.			
15	0	6	M
MARCH.			
Immerſions.			
6	2	32	M
22	8	54	A
Emerſions.			
6	26	45	M
23	1	1	M
APRIL.			
Immerſions.			
8	3	14	A
25	9	33	M
Emerſions.			
8	7	17	A
25	1	29	A
MAY.			
Immerſions.			
12	3	49	M
28	10	4	A
Emerſions.			
12	7	39	M
29	1	48	M
JUNE.			
Immerſions.			
14	4	18	A
Emerſions.			
14	7	50	A
JULY.			
Immerſions.			
1	10	30	M
18	4	46	M
Emerſions.			
1	2	0	A
18	8	9	M
AUGUST.			
Immerſions.			
3	11	7	A
20	5	30	A
Emerſions.			
3	14	20	A
SEPTEMBER.			
Immerſions.			
23	6	22	M
Emerſions.			
6	2	48	A
23	9	8	M
OCTOBER.			
Immerſions.			
10	0	48	M
26	7	12	A
Emerſions.			
10	3	23	M
26	9	35	A
NOVEMBER.			
Immerſions.			
12	1	15	A
29	7	51	M
Emerſions.			
12	3	25	A
20	9	47	M
DECEMBER.			
Immerſions.			
16	3	9	M
Emerſions.			
16	4	49	M

III. *The apparent Times of ſuch of the* Immerſions *and* Emerſions *of* Jupiter's *Satellites, as are viſible at* London *in the Year* 1737. *By* James Hodgſon, *F. R. S.* (See TAB. I.)

	D.	H.	M.	
	JANUARY.			
1	10	4	44	E E. 1
2	18	5	13	E E. 2
	MARCH.			
3	8	5	49	M I. 1
	APRIL.			
4	16	4	28	M I. 1
5	28	3	6	M I. 2
	MAY.			
6	2	2	47	M I. 1
7	12	3	49	M I. 4
8	17	2	25	M E. 3
9	24	3	4	M I. 3
10	25	2	56	M I. 1
11	29	1	48	M E. 4
12	30	2	45	M I. 2
	JUNE.			
13	10	1	9	M I. 1
14	17	3	2	M I. 1
15	23	11	46	E I. 2
16	25	11	23	E I. 1
17	28	11	1	E I. 3
18	29	2	17	M E. 3
	JULY.			
19	1	2	20	M I. 2
20	3	1	16	M I. 1
21	6	3	1	M I. 3
22	10	3	9	M I. 1
23	18	4	46	M I. 4
24	18	11	32	E I. 1
25	25	11	26	E I. 2
26	26	1	27	M I. 1
	AUGUST.			
27	2	2	3	M I. 2
28	2	3	22	M I. 1
29	3	9	51	E I. 1
30	3	11	7	E I. 4
31	4	2	20	M E. 4
32	9	4	41	M I. 2
33	10	11	10	E I. 3
34	10	11	47	E I. 1
35	18	1	44	M I. 1
36	18	3	13	M I. 3
37	19	8	39	E I. 2
38	25	3	41	M I. 1
39	26	10	11	E I. 1
40	26	11	17	E I. 2
	SEPTEMBER.			
41	3	2	21	M E. 1
42	3	4	43	M E. 2
43	4	8	50	E E. 1
44	8	6	32	E I. 3
45	10	4	18	M E. 1
46	11	10	47	E I. 1
47	13	8	41	E I. 2
48	15	10	36	E E. 3
49	19	0	43	M E. 2
50	20	7	14	E E. 1
51	20	11	20	E E. 2
52	23	2	39	M E. 3
53	26	2	42	M E. 1
54	28	1	59	M E. 2
	OCTOBER.			
55	4	11	8	E E. 1
56	8	5	57	E E. 2
57	10	0	48	M I. 4
58	12	1	5	M E. 1
59	13	7	34	E E. 1
60	15	8	35	E E. 2
61	20	9	29	E E. 1
62	21	6	49	E E. 3
63	22	11	12	E E. 2
64	26	7	12	E I. 4
		9	35	E E. 4
66	27	11	25	E E. 1
67	28	7	49	E I 3
68	28	10	56	E E. 3
69	29	5	53	E E. 1
	NOVEMBER.			
70	4	1	19	M E. 1
71	4	11	51	E I. 3
72	5	7	48	E E. 1
73	9	5	43	E E. 2
74	12	9	42	E E. 1
75	16	8	18	E E. 2
76	19	11	35	E E. 1
77	21	6	3	E E. 1
78	23	10	53	E E. 2
79	28	7	55	E E. 1
	DECEMBER.			
80	5	9	47	E E. 1
81	10	7	50	E I 3
82		10	45	E E. 3
83	11	5	17	E E. 2
84	14	6	8	E E. 1
85	17	11	49	E I. 3
86	18	7	51	E E. 2
87	21	7	59	E E. 1
88	28	9	52	E E. 1

The 2*d*, 5*th*, and 8*th* Columns, ſhew the Times when the Eclipſes will happen; the 3*d*, 6*th*, and 9*th*, the Kind. Thus, on the 10*th* of *January*, at 4 h. 44 m. in the Evening there will happen an Emerſion of the firſt Satellite; and the Number 1, which is placed againſt the 10*th* of *January* in the 1ſt Column, refers to the Number 1 in the 1ſt Column of the *Plate* of *Configurations*, againſt which is placed the *Correſpondent Configuration*, or the Form in which the Satellites will appear at that Time.

IV. *A*

IV. *A Propoſition relating to the Combination of* Tranſparent Lens's *with* Reflecting Planes. *By* J. Hadley, *Eſq;* *V. Pr. R. S.* *Communicated to the* Royal Society, January 9, 1734.

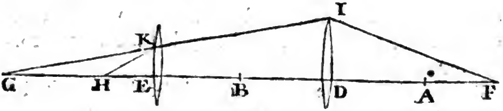
HAVING propoſed the uſing of a Teleſcope with the Inſtrument for taking Angles, which I formerly laid before this Society, (*See* N° 420.) it gave me Occaſion to conſider the Effects of the combining ſeveral Kinds of Teleſcopes with reflecting Planes, and, among others, led me to the following Propoſition.

That if two Lens's of equal focal Length be put together in the Form of a Teleſcope, and a Plane Speculum be placed before one of them, ſo that the Axis of the Teleſcope make any Angle with its Surface, and a Ray of Light (the Line of whoſe Direction lies in a Plane perpendicular to that Surface, and paſſing through the Axis of the Teleſcope) fall on it, and be reflected from it, ſo as to paſs through the Teleſcope; then the Line of its laſt Direction, after paſſing the Teleſcope, will make an Angle with that of its firſt Direction, before its Incidence on the Speculum, very nearly equal to double the Angle made between the Axis of the Teleſcope, and the Surface of the Speculum.

LEM-

LEMMA

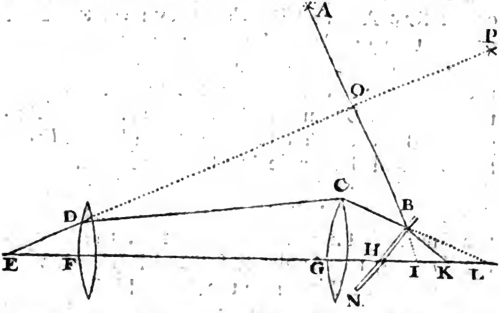
Let the Line FG be the common Axis of the two Lens's I D and K E, of equal focal Lengths; to which let the Lines A D, D B and B E, be each equal; and let a Ray of Light, iſſuing from a Point in the Axis F, fall on the Lens I D at I, and be there refracted into the Line I G, cutting the Axis in G, and meeting the Lens K E in K, where let the Ray be again refracted into the Line K H, cutting the aforeſaid Axis in H: The Angles I F D and K H E are very nearly equal.



DEMONSTRATION.

It is known from Doptricks, that the Lines F I, I G, K H, and F G, are all in the ſame Plane; and by the Conſtruction the Lines A D, D B, and B E are equal; and by *Propoſ.* 20 of Huygens's *Dioptricks*, the Lines F A, F D, and F G are continually proportional; and conſequently F A is to A D as F D to D G, and dividing, F A is to A D as F D — F A (= to A D) is to D G — A D (= to B G.) Therefore A D is to B G as F D to D G. By the ſame *Propoſition*, the Lines B G, E G, and H G are alſo continually proportional, and B E (= to A D) is to B G as E H is to E G. Hence it follows, that the Lines F D, D G, and E H, E G, are Proportionals. But as F D is to D G, ſo is the Tangent of the Angle I G D or K G E to the Tangent of the Angle I F D; and as E H is to E G, ſo is the Tangent of the Angle K G E to the Tangent of the Angle K H E. The Tangent of the Angle K G E therefore has the ſame Proportion to the Tangents of each of the Angles I F D and K H E, and conſequently thoſe Angles are equal. *Q. E. D.*

N. B. In the Demonſtration of the above-cited Propoſition of *Huygens*, the Thickneſs of the Lens's are neglected, and the Diſtance of the Points I and K, from the Line F G, ſuppoſed very ſmall; ſo that if either of thoſe are too great, there may ariſe a ſenſible Difference between the Angles I F D and K H E.



Let D F and C G repreſent the two Lens's put together as before, having their common Axis in the Line E L, and B N a plane Speculum to which that Line is inclined in the Angle G H N, and let

A B be a Ray of Light falling on the Speculum at B, as is before expreſſed, and let it be there reflected towards the Point C of the Lens C G, where it is refracted towards the Point D of the Lens D F, and there again refracted into the Line D E, cutting the Axis in E. The Angle A O P contained between this laſt Line D E, continued backwards, and the firſt Line of Incidence of the Ray A B, will be very nearly equal to double the Angle of Inclination of the Axis of the Lens's E L to the Plane of the Speculum B N; *i. e.* double the Angle G H N.

DEMONSTRATION.

Produce the Lines of Incidence and Reflection of the Ray A B and B C, 'till they meet the Axis of the two Lens's in I and L; and through the Point B draw B K perpendicular to the Plane of the Speculum, and cutting the ſame Axis in K, the Angles K B L and K B I are equal. The Angle K L B is the Difference of the Angles I K B and K B L; and the Angle H I B is the Sum of the Angles I K B and K B I (equal to K B L): Therefore the Angle I K B is equal to half the Sum of the Angles H I B and K L B. But by the 'foregoing *Lemma*, the Angles K L B and F E D are very nearly equal. Therefore the Angle I K B is nearly equal to half the Sum of the Angles H I B and F E D; that is, to half the Angle P O B, and its Complement B H I or G H N is nearly equal to half the Angle A O P the Complement of P O B to a Semicircle. *Q. E. D.*

If the firſt Incidence of the Ray be ſuppoſed to be in the Line E D, it will proceed in the ſame Track as before, but with the contrary Directions; ſo that the Angle E O B made between the firſt incident Ray and the laſt reflected, will ſtill be equal to the Double of G H N, as before.

It is evident that on this Principle an Inſtrument might be conſtructed, the Effects of which would in a great Meaſure reſemble thoſe of that before mentioned (N° 420): But it would be liable to the Errors ariſing both from the ſpherical Figure of the Lens's, and alſo the different Refrangibility of the Rays of Light, when the Object is ſeen at a Diſtance from the Axis of the Teleſcope; altho' thoſe Errors, by a proper Diſpoſition of the Parts of the Inſtrument, may be reduced to a very ſmall Quantity. However, for this Reaſon, and alſo becauſe the Inſtrument ſeemed to me to be attended with greater Inconveniencies, both in its Conſtruction and Uſe, than the other, I have not thought it neceſſary to give any more particular Deſcription of it.

V. *An Account of a large* Bony Subſtance *found in the* Womb, *which was ſhewn to the* Royal Society, May *the* 17*th*, 1733, *by* Edward Hody, *M. D. F. R. S.*

E—— *S*——, aged 57, died in St. *James's Market*, *January*, 1725. In examining the *Pelvis* of this Woman, I found a large *Bony-*

Subſtance, which was contain'd in the Womb, and ſo ſtrictly united to it, that they ſeem'd to be one and the ſame Body. Upon cutting the *Subſtance* aſunder, I obſerv'd, that the *Oſſification* went no farther than the Thickneſs of a Shilling; the Part immediately under the *Oſſification* is like firm Fleſh, and this Fleſh grows ſofter and ſofter as it draws near to its Center.

I think it not unneceſſary, the Bone being found in, and ſo ſtrictly united to the Womb, to take Notice, that the Woman never had but one Child, of which ſhe was deliver'd about twenty-ſeven Years before ſhe died: And it may not be improper to mention the Symptoms that ſhe had long labour'd under, and the immediate Cauſe of her Death.

Her chief Complaints, for ſome Years, were a ſhort Cough, great Difficulty in Breathing, frequent Uneaſineſs in making Water, or in going to Stool, and a conſtant Weight, or Bearing down, upon the Parts of Generation.

The immediate Cauſe of her Death was, undoubtedly, an *Aſthma*; for ſhe had only one *Lobe* of the *Lungs* left that was perfectly ſound; the reſt adher'd firmly to the *Pleura*, were very much contracted, and in ſome Places ſcirrhous.

EXPLICATION *of the Figure* TAB II.

A The *Bony-Subſtance.*
B The Subſtance of the *Womb* cut open, and turn'd backwards.

C Small *Fibres* connecting the *Bony-Subſtance* with the *Womb.*
D The right *Fallopian Tube* lying upon the *Membrane,* which joins the *Tube* to the *Womb* and to the *Ovarium.*
E The *Ovarium.*
F The *Morſus Diaboli.*
G The left *Fallopian Tube* cut off.
H The Neck of the *Womb* cut open, as elongated by the Diſeaſe.
I The Mouth of the *Womb* laid open.
K The greateſt Part of the *Vagina* likewiſe laid open.

This *Womb,* with the *Bone* adhering to it, having been kept ten Years in Spirits before it was ſent to the Engraver, the *Vagina, Fallopian Tube,* the *Membrane* on which the *Tube* lies, and the *Ovarium,* muſt be ſuppoſed to be greatly contracted; but that Part of the *Womb* diſtended by the Subſtance, is indeed very little contracted; for it was ſcarce ſo thick as a Half-Crown Piece when it was firſt taken out of the Body.

VI. *Some Experiments concerning the* Impregnation *of the* Seeds *of* Plants, *by* James Logan, *Eſq; Communicated in a Letter from him to Mr.* Peter Collinſon, *F. R. S.*

Philadelphia, Nov. 20, 1735.

S I R,

* * * * * * * * * * * * * * *

AS the Notion of a Male Seed, or the *Farina Fœcundans* in Vegetables is now very common, I ſhall not trouble you with any Obſervations concerning it, but ſuch as may have ſome Tendency to what I have to mention —— And, firſt, I find from *Miller*'s Dictionary, that M. *Geoffroy*, a Name I think of Repute amongſt *Naturaliſts*, from the Experiments he made on *Mayze*, was of Opinion, that Seeds may grow up to their full Size, and appear perfect to the Eye, without being impregnated by the *Farina*, which poſſibly, for ought I know, may in ſome Caſes be true; for there is no End of Varieties in Nature:—— But in the Subject he has mention'd I have Reaſon to believe it's otherwiſe, and that he applied not all the Care that was requiſite in the Management.

When I firſt met with the Notion of this Male Seed, it was in the Winter Time, when I could do no more than think of it; but in the Spring I reſolved to make ſome Experiments on the *Mayze*, or *Indian Corn*. In each Corner of my Garden, which is forty Foot in Breadth, and near eighty in Length, I planted a Hill of that Corn, and watching the Plants when they grew up to a proper Height, and were puſhing out both the Taſſels above, and Ears below; from one of thoſe Hills, I cut off the whole Taſſels, on others I carefully open'd the Ends of the Ears, and from ſome of them I cut or pinch'd off all the ſilken Filaments; from others I took about half, from others one fourth and three fourths, *&c.* with ſome Variety, noting the Heads, and the Quantity taken from each: Other Heads again I tied up at their Ends, juſt before the Silk was putting out, with fine Muſlin, but the Fuzzieſt or moſt Nappy I could find, to prevent the Paſſage of the *Farina*; but that would obſtruct neither Sun, Air or Rain. I faſtened it alſo ſo very looſely, as not to give the leaſt Check to Vegetation.

The Conſequence of all which was this, that of the five or ſix Ears on the firſt Hill, from which I had taken all the Taſſels, from whence proceeds the *Farina*, there was only one that had ſo much as a ſingle Grain in it, and that in about four hundred and eighty Cells, had but about twenty or twenty one Grains, the Heads, or Ears, as they ſtood on the Plant, look'd as well to the Eye as any other; they were of their proper Length, the Cores of their full Size, but to the Touch, for want of the Grain, they felt light and yielding. On the Core, when diveſted of the

Leaves that cover it, the Beds of Seed were in their Ranges, with only a dry Skin on each.

In the Ears of the other Hills, from which I had taken all the Silk, and in thoſe that I had cover'd with Muſlin, there was not ſo much as one mature grown Grain, nor other than as I have mentioned in the firſt: But in all the others, in which I had left Part, and taken Part of the Silk, there was in each the exact Proportion of full Grains, according to the Quantity or Number of the Filaments I had left on them. And for the few Grains I found on one Head in the firſt Hill, I immediately accounted thus: That Head, or Ear, was very large, and ſtood prominent from the Plant, pointing with its Silk Weſtward directly towards the next Hill of *Indian* Corn; and the *Farina*, I know, when very ripe, on ſhaking the Stalk, will fly off in the fineſt Duſt, ſomewhat like Smoak. I therefore, with good Reaſon, judged that a Weſterly Wind had wafted ſome few of theſe Particles from the other Hill, which had light on the Stiles of this Ear, in a Situation perfectly well fitted to receive them, which none of the other Ears, on the ſame Hill, had. And indeed I admire that there were not more of the ſame Ear than I found impregnated in the ſame manner.

As I was very exact in this Experiment, and curious enough in my Obſervations, and this, as I have related it, is truly Fact, I think it may reaſonably be allowed, that notwithſtanding what M. *Geoffroy* may have deliver'd of his Trials on the ſame Plant, I am poſitive, by my Experiment on thoſe Heads, That the Silk was taken quite away, and thoſe that were cover'd with Muſlin, none of the Grains will grow up to their Size, when prevented of receiving the *Farina* to impregnate them, but appear, when the Ears of Corn are diſcloſed, with all the Beds of the Seeds, or Grains, in their Ranges, with only a dry Skin on each, about the ſame Size as when the little tender Ears appear fill'd with milky Juice before it puts out its Silk. But the few Grains that were grown on the ſingle Ear, were as full and as fair as any I had ſeen, the Places of all the reſt had only dry empty Pellicles, as I have deſcribed them; and I much queſtion whether the ſame does not hold generally in the whole Courſe of Vegetation, though, agreeable to what I firſt hinted, it may not be ſafe to pronounce abſolutely upon it, without a great Variety of Experiments on different Subjects. But I believe there are few Plants that will afford ſo fine an Opportunity of obſerving on them as the *Mayze*, or our *Indian Corn*; becauſe its Stiles may be taken off or left on the Ear, in any Proportion, and the Grains be afterwards number'd in the Manner I have mentioned.

VII. *Some*

VII. *Some* Obſervations *of Eclipſes of* Jupiter's Satellites, *made by* Geo. Lynn, *Eſq*; *at* Southwick, *near* Oundle *in* Northamptonſhire; *Communicated in a Letter to* James Jurin, *M. D. F. R. S. and Fellow of the* Royal College *of* Phyſicians, London.

S I R,

HEARING that ſome Foreigners enquired for Obſervations of the Eclipſes of *Jupiter*'s Satellite, I have ſent what I had of that Sort: They are indeed but few theſe two laſt Years, on account of my Abſence during part of the Time for Obſervation, and alſo on account of the ſmall Arc *Jupiter* has lately made above our Horizon. The Teleſcope I made uſe of is the ſame as formerly, having a thirteen Foot Object-Glaſs, with an Aperture of two Inches and four Tenths, and an Eye-Glaſs of two Inches and an half Focus. By apparent Time, at *Southwick*, near *Oundle* in *Northamptonſhire*, Longitude Weſt from *London*, 00 Deg. 30 Min. as follows:

	Month.	D.	h.	′	″
1730. The 2d Satellite began to emerge ——	*April*	29	10	19	20
It ſeemed in a Minute after to be as bright as the 4th Satellite ——				20	20
And at full Brightneſs about ——				21	20

The

		Month.	D.	h.	′	″
$17\frac{29}{30}$.	The 4th Satellite emerged	*Jan.*	25	9	45 nearly	
1730.	The 2d began to immerge	*Nov.*	28	13	17	46
	And was quite out of Sight at				19	46
1731.	The 2d began to emerge	*March*	29	11	33	8
	And ſeem'd at full Brightneſs about				36	30
	The 1ſt Satellite began to emerge ——	*April*	18	11	45	10
	And was at full Brightneſs about				46	10
	Again the 1ſt began to emerge	*May*	4	10	4	30
	Was at full Brightneſs about ——				5	45
	And paſſed by the 3d Satellite at			11	49	30
$17\frac{30}{31}$.	The 1ſt Satellite began to immerge ——	*Jan.*	7	12	2	55
	And was quite out of Sight about				4	25
$17\frac{31}{32}$.	The 3d Satellite began to immerge ——	*Jan.*	28	14	16	00
	Was but equal in Light to the 2d at				19	00
	Quite gone at —— ——				24	00
1732.	The 2d Satellite began to emerge ——	*April*	30	12	23	57
	The 1ſt Satellite began to emerge ——	*May*	6	12	48	44
$17\frac{32}{33}$.	The 3d Satellite quite diſappeared ——	*Febr.*	18	13	5	30
1733.	Again the 3d Satellite diſappear'd ——	*April*	2	13	3	30
	But it began to fail of its Light about 5 or 6 Minutes before.					
1735.	The 2d Satellite immerged	*May*	28	10	45	00
	The 3d began to emerge	*Auguſt*	3	9	10	30

And was 4 or 5 Minutes before it came to its full Brightneſs.

VIII. *A Letter from Mr.* Thomas Jones *to* James Jurin, *M. D. F. R. S. and Fellow of the* Royal College *of Phyſicians,* London, *concerning the* High Tide *in the River* Thames, *on* Feb. 16, 1735-6.

SIR,

AS you was pleaſed to deſire an Account of the Tide's flowing on the 8th of *March,* 1725-6, which then flowed twenty Foot five Inches and a half, as I took it by a Level from that High Water Mark to Low Water the next Morning, and was four Inches higher than had been known for forty Years before.

I have now to add, that having mark'd that High Tide on a Poſt, on *Monday* the 16th Inſtant the Tide roſe at the ſame Place ſix Inches and three Quarters above that Mark, and flowed near two Foot the laſt half Hour but one before High Water. I am,

SIR,

New-Crane, Feb. 17th, 1735-6.

Your moſt humble, and
obedient Servant,

THO. JONES.

N. B. If the Tide had flowed its full Time, it would have flowed half an Hour longer, and had drowned the whole Level.

IX. Affectus

IX. Affectus Cutaneus ſingularis, *ab* Abrahamo Vatero, *Anatomes & Botanices in Academia* Wittembergenſi *Profeſſore publico, R. S. S.* Regali Societati *communicatus.*

IN Tranſactionibus Philoſophicis Illuſtriſſimæ Societatis Regiæ, N° 424, pro Menſibus Julio & Auguſto, Anno MDCCXXXII, recenſetur Caſus rariſſimus pariter ac curioſiſſimus, cutis, aut potius cuticulæ prave conſtitutæ in puero ruſtico XIV annorum, quæ talem craſſitiem & duritiem habet, ut corticem potius arboris, quam cutem humani corporis referat, quæ thecæ inſtar totum corpus, excepta facie, voliſque manuum ac pedum, ita involvit, ut puer quaſi in ea reconditus videatur, quam quotannis regeneratam autumni tempore, exuviarum inſtar, decidentem exuit ac deponit. Caſum hunc apprime illuſtrat, quam nuper a Medico Clariſſimo, Domino Licentiato Harniſchio, Gera in Variſcia Illuſtriſſimorum Comitum Ruthenicorum ſede, ad me perſcriptam accepi, hiſtoria puellæ IIX annorum, ibidem viventis. Hæc ante aliquot annos tumore artuum & totius corporis laboraverat, ad quem curandum, cum varia a parentibus remedia, præcipue domeſtica aut empirica adhiberentur, factum eſt, ut tumor durus inſignis in dorſo inter ſcapulas generaretur, quem gibberis initium judicantes itidem topicis diſcutere ſtuduerunt votique etiam ſui compotes facti ſunt. At quid fit? Ab iſto tempore ſenſim in manibus pedibuſque, imprimis in horum plantis ac iſtarum volis, generari cœpit cruſta ſicca atque dura, quæ in apicibus digitorum longe prominet, ac apprehenſionem greſſumque impedit, adeo ut puella nec ſtare, nec incedere potuerit, ſed portari ac curru vehi opus habuerit. Cruſta hæc per intervalla decidit, præprimis poſt inunctiones varias a parentibus applicatas, ſed puella inde male habuit, tumida evaſit, anxietates & tormina intus ſenſit, quæ non niſi cruſta iſta regenerata ceſſarunt; hoc autem facto, nil amplius incommodi percepit, præterquam quod uſu manuum pedumque deſtitueretur. Ab anni ſpatio denuo hoc malo afflicta Chirurgi curæ tradita fuit, qui illam laxantibus Mercurialibus atque decoctis ſanguinem purificantibus tractavit, quibus etiam malum ceſſit, ac munditics cutis reſtituta eſt, adeo ut puella nunc integra ſanitate frui videatur: quæ an conſtans ſit futura, tempus docebit. Accepi a laudato Medico portionem hujus cruſtæ, cum fruſtulo ejuſdem ab apice digiti deciduo, tantæ longitudinis & craſſitiei, ut extremum digiti articulum referat, eo magis, quia in uno latere particulam unguis monſtrat. Microſcopio inſpecta hæc cruſta, manifeſto apparet, eam ex ſquamulis conflatam eſſe, quod eo certius eſt teſtimonium, illam nil aliud, quam ipſam cuticulam, a nutrimento viſcido & tartareo expanſam & induratam eſſe. Ex ejuſdem ſupra laudati Viri relatione habeo, in urbe ibidem vicina pariter reperiri virginem, quæ a longo inde tempore, bis in anno, talem deponit cruſtam, a manibus pedibuſque, necnon a cubito deciduam, quæ nullam a quibuſcunque Medicamentis hactenus

uſurpatis, levamen percepit. Laborat autem iſta obſtructione menſium, quæ mali huhus fons atque origo eſſe videtur.

Wittenbergæ D. 1 *Auguſt.*
A. D. MDCCXXXV.

X. Experiments *concerning the* Vibrations *of* Pendulums. *By the late* W. Derham, *D. D. F. R. S. and Canon of* Windſor.

THE Account which Mr. *Bradley* hath given in *Philoſoph. Tranſact.* N° 432, of Obſervations made at *Jamaica* by Mr. *Campbel*, with a nice *Pendulum-Clock* of Mr. *Graham*'s making, brought to my Mind ſome Experiments I made ſome Years ago, that may be of Uſe in Obſervations of this nature.

The firſt that I ſhall take notice of, ſhall be ſome Experiments I made in the Year 1704, with excellent Inſtruments, concerning the *Vibrations of Pendulums in Vacuo*; which were publiſhed in the *Philoſoph. Tranſact.* N° 294. The Sum of which is, That the Vibrations in *Vacuo* were larger than in the *open Air*, or Receiver unexhauſted: Alſo that the Enlargement or Diminution of the Vibrations, was conſtantly in Proportion to the Quantity of Air, or Rarity, or Denſity thereof, which was left in the Receiver of the Air-Pump. And as the Vibrations were larger or ſhorter, ſo the Times were augmented, or diminiſhed accordingly; *viz.*

two Seconds in an Hour ſlower, when the Vibrations were largeſt, and leſs and leſs, as the Air was re-admitted, and the Vibrations ſhortened.

But notwithſtanding the Times were ſlower, as the Vibrations were larger, yet I had Reaſon to conclude, that the Pendulum really moved quicker in *Vacuo*, than in the *Air*, becauſe the ſame Difference, or Enlargement of the Vibrations (as two Tenths of an Inch on a Side) would cauſe the Movement, inſtead of two Seconds in an Hour, to go 6 or 7 Seconds ſlower in the ſame time; as I found by nice Experiments.

The next Experiments I ſhall mention, I made at ſeveral Times, in 1705, 1706, and 1712, by the Help of a good Month-Piece that ſwings Seconds. The Weight that then drove it, was about 12 or 13 Pounds, and it kept Time exactly by the Sun's mean Motion: But by hanging on 6 Pounds more, the Vibrations were enlarged; but yet the Clock gained 13 or 14 Seconds in a Day.

And as the Increaſe or Diminution of the Power that drives the Clock, doth accelerate or retard its Motion, ſo, no doubt, doth *Cleanneſs* or *Foulneſs* affect it, and ſo doth *Heat* and *Cold*; for all have the ſame Effect upon the Pallets and Pendulum.

The laſt Experiments I ſhall mention, I made in 1716 and 1718, to try what Effects *Heat* and *Cold* had upon *Iron Rods* of the ſame Length, or as near as I could to thoſe that ſwing Seconds. I made my Experiments with round Rods of about a Quarter of an Inch Diameter, and with ſquare Rods, of about three Quarters of an Inch Square. The Effects on both which were the ſame.

At firſt I took the exact Length of the Rods, in their natural Temper. Then I heated them as well as I could in a Smith's Fire, from End to End, nearly to a *Flaming Heat*; by which means, they were lengthened two Tenths of an Inch. Then I *quenched* them in cold Water; which made them $\frac{2}{100}$ of an Inch ſhorter than in their natural State.

Then I warmed them to (as near as I could gueſs) the *Temper* of my Body; by which means they were about $\frac{1}{100}$ of an Inch longer than in their natural Temper.

Afterwards I cooled them in a *ſtrong frigorifick Mixture* of common Salt and Snow, which ſhortened them $\frac{2}{100}$ Parts of an Inch.

Afterwards I meaſured theſe Rods, when heated in an *hot Sun*, which lengthened them $\frac{2}{100}$ Parts of an Inch more than their natural Temper.

All theſe Experiments ſeem to concur in reſolving the Phænomenon of *Pendulum Clocks going ſlower under the Æquator* than in the Latitudes from it: But yet I confeſs, that I have too good an Opinion of Sir *Iſaac Newton*'s Notion of the Sphæroidal *Figure* of the *Earth*, to part eaſily with it; and therefore I leave it to the Conſideration of others, how far the Figure of the Earth, and how far Heat and Cold, and the Rarity and Denſity of the Air, are concerned in that Phænomenon.

XI. *The*

XI. *The* Conſtruction *and* Uſe *of* Spherical Maps, *or ſuch as are delineated upon Portions of a* Spherical Surface. *By Mr.* John Colſon, M. A. *F. R. S.*

GEographical Maps, and Hydrographical Charts, though they are Repreſentations of a Convex Spherical Surface, yet were firſt delineated upon Planes, as being the moſt eaſy and obvious, tho' not the moſt natural and accurate Repreſentations: And they will be ſufficiently near the Truth, when the Part of the Earth or Seas to be deſcribed is not of a very large Extent. Such as theſe have been uſually called Chorographical and Topographical Maps; but when the Map is any thing general, or is to contain any large Tract of the Earth or Seas, ſuppoſe (for Inſtance) one of the four Quarters of the World, as they are call'd; then, when they are projected, or repreſented upon a Plane, the Parts muſt neceſſarily be diſtorted, one way contracted beyond the Truth, another way dilated, ſo as to give no juſt Idea of the whole. Nor can this Diſtortion be poſſibly avoided, when any conſiderable Part of a Spherical Surface, by any Projection whatever, is to be repreſented upon a Plane. 'Tis true, this Diſtortion is always regular, and according to certain Laws; ſo that knowing the Nature of the Projection, it may tolerably well be allow'd for. But to do this ſcientifically, and as it ought to be done, requires much Skill and Accuracy in the

Maker, as well as good Proficience and Experience in the Peruſer; and therefore not ſo proper for an Introduction to Learners, in the Rudiments of Geography. Young Minds are apt to receive wrong Notions and Prejudices from them, at leaſt cannot be rightly and eaſily inſtructed by them.

To obviate this Inconvenience, Geographers have contrived and conſtructed the Terreſtrial Globe, on which they endeavour to delineate all the Parts of the Earth's Surface in their natural State, as to Longitude, Latitude, Diſtance, Bearing, Magnitude, *&c.* which being a true and genuine Repreſentation of the whole Superficies of the Earth, as far as it is yet known, is the beſt adapted for conveying juſt Notions to young Minds, and for preventing all falſe Conceptions and Prepoſſeſſions. After the firſt Rudiments of Geography have been imbibed from hence, they will be then prepared for the Uſe of plain Maps; and they will afterwards find, that large Projections of particular Countries, Kingdoms and Provinces, *in plano*, will be of excellent Service to them for their farther Improvement in this uſeful and neceſſary Science. Nor will they now be in any Danger of being miſled by ſuch Maps, tho' they are not ſo juſt and natural Repreſentations of the Earthly Globe.

Now the ſame Conveniencies that may be derived from the whole Globe, may, in Proportion, be had from any notable Portions of it; as an Hemiſphere, a Quadrant, a Sectant, an Octant, or other Part. But with this Advantage beſides, that theſe partial Spherical Maps will not only be much leſs cumberſome, and more manageable than a whole Globe,

but

but may be made much more accurate and particular, as being capable of being form'd to a much larger Diameter than a Globe can conveniently be made to. The Maps may firſt be printed upon a Plane, as is uſual in the common Globes, and then paſted upon thin convex Shells of Paſtboard, form'd to the intended Radius. The forming of theſe ſpherical Coats of Paſtboard will be a Matter of no great Difficulty, even to as large a Diameter as ſhall be deſired; but the chief Art will be required in projecting the Maps *in plano*, after the ſimpleſt and exacteſt Manner, ſo as that they may adapt themſelves, with as little Error as poſſible, to a ſpherical Surface. For a plane Surface cannot be converted into a ſpherical Surface without ſome Error. The beſt Method of doing this, with the leaſt poſſible Error, I think will be as follows.

Inſtead of the uſual Slips or Guſſets, as is the manner of Globe-makers, which are comprehended between two Meridians at ſome Diſtance, and are form'd only tentatively and mechanically, without the Help of any juſt Theory, we may divide the whole ſpherical Surface into parallel Portions, or Zones; that is, into Parts terminated by two Parallels to the Equator, at the Diſtance (ſuppoſe) of ten Degrees. As if the firſt of theſe Portions, or Zones, were at the Equator itſelf, and extended to five Degrees of Latitude on each Side of that Circle, the ſecond Zone would be at the Parallel of ten Degrees of Latitude, and would extend to five Degrees of Latitude on one Side, and to fifteen Degrees of Latitude on the other Side of that Parallel, and ſo of the ſucceeding Zones.

Now we may conceive the firſt of theſe Portions, or Zones, to be converted from a ſpherical Surface to a plane Surface in this manner, without ſenſible Error. Let the middle Line of this Zone, that is the Equator, continue in its Situation, and let the Segments of the Meridians on each Side be conceived to unbend themſelves gradually, 'till they are extended into right Lines perpendicular to the Equator: Then will that which was before a Zone, or Portion of a ſpherical Surface, with a ſmall Alteration become a Portion of a cylindrical Surface, circumſcribed about the Sphere; whoſe Breadth is every where equal to ten Degrees of the Sphere, and whoſe Circumference is equal to the Equator. And thus every Parallel to the Equator, as far as that of five Degrees of Latitude on each Side, will be ſtretch'd and extended into a Circle as large as the Equator; but they will all keep the ſame Diſtance from one another, and from the Equator, that they had before. This Extenſion, or Alteration, will be every where regular and uniform, and will be but very little, even where it is moſt: For the leaſt of theſe Circles, which is the Parallel of five Degrees of Latitude, has the ſame Proportion to the Circle it is ſtretch'd to, or the Equator, as the Sine of 85 Degrees has to the Radius, or as 9961947 to 10000000; which approaches very near to a Ratio of Equality. And now it will be eaſily conceived, that without undergoing any other Alteration, or Diſtortion, this Portion of a cylindrical Surface may be rectified, or extended into a plane Parallelogram, whoſe Length will be equal to that of the Equator, and whoſe Breadth will be equal to an Arch of 10 Deg. of the ſame Equator.

And conſequently, by an Operation that will be juſt the Reverſe of this, if upon a Plane we delineate ſuch a Parallelogram as this, we may then lay down all the Places that are contain'd in it very exactly, in their proper Situation of Longitude and Latitude; and then apply its middle Line, or Equator, to that of a Globe of a due Magnitude, which will then become a Portion of a cylindrical Surface, circumſcribed about the Globe. Then by preſſing it cloſe to the Body of the Globe, we ſhall cauſe it to contract itſelf a very little, but regularly, which Contraction will be only according to Longitude, and not at all according to Latitude; and then the cylindrical Surface will be changed into that of a Sphere, and will become the firſt ſpherical Zone before deſcribed, with all its Delineations in their due Poſition, without ſenſible Error.

In like manner in the ſecond ſpherical Portion, or Zone, comprehended between the Parallels of five and fifteen Degrees, whoſe middle Line is the Parallel of ten Degrees, we may conceive the Segments of the Meridians to unbend gradually on each Side, and to extend themſelves into Tangent right Lines, which therefore will form a Segment of a conical Surface, ſtill touching the Globe in the Parallel of ten Degrees of Latitude. The Axis of this Cone will coincide with the prolonged Axis of the Globe, and the Side of the Cone, which is to be eſtimated from the Vertex to the Circle of Contact, will be the Co-tangent of the Latitude, or the Tangent of 80 Degrees. Now this Portion of a conical Surface may eaſily be conceived to be unroll'd, or to be expanded into a plane Surface, without undergoing any other Alteration, and then it will become a Portion of a Sector of a Circle; which Portion will have for its Length, or middle Line, an Arch of a Circle deſcribed with the aforeſaid Tangent, as a Radius, whoſe Length will be the ſame as the Parallel of Contact, and its Breadth will be equal to an Arch of the Equator of ten Degrees, as before. This Segment of a Sector of a Circle ſo produced, may therefore be eaſily deſcribed *in plano*, and within it may be inſerted all the Places belonging to it, according to their Longitude and Latitude. Then it muſt be applied to the Globe, ſo as that its middle Line ſhall coincide with the Parallel of ten Degrees; then by preſſing it may be bent to the Surface of the Globe, every Meridian to its reſpective Repreſentative, by which it will uniformly contract a little according to Longitude, but not at all according to Latitude. And thus the Globe will be cover'd as far as 15 Degrees of Latitude.

The next Zone, or that belonging to the Parallel of 20 Degrees, may be thus conſtructed *à priori*. Upon a plain Paper, with Radius equal to the Tangent of 70 Degrees, deſcribe an Arch, whoſe Length is equal to that of the Parallel of 20 Degrees; as alſo two other concentrick Arches on each Side, at a Diſtance from the middle Arch equal to an Arch of five Degrees. This will be the required Segment of the circular Sector, in which are to be inſerted all the Places belonging to it, according to their Longitude and Latitude. Then the middle Line or Arch is to be apply'd to the Parallel of 20 Degrees upon the Globe, and the Segment of the conical Surface thence ariſing is to be duly contracted as before, or preſs'd cloſe to the Globe; by which Means this Zone will alſo be compleated. And in the ſame manner we are to proceed to the ſucceeding Zones, 'till the whole Globe is cover'd. And the Method will not differ in any material Circumſtance, if inſtead of a whole Globe, we are to conſtruct any Part of it only, or what I here call a Spherical Map.

To reduce this Theory to Practice, and as a Specimen of Spherical Maps, I have conſtructed a Terreſtrial Hemiſphere to a Diameter of near 15 Inches: To which I have given the Name of the *Britiſh Hemiſphere*, becauſe it has *Great-Britain* in the Center, or rather at its Vertex. It is therefore adapted to the Meridian and Horizon of *London*, and exhibits one half of the Earth's Surface, as it lies round about this City; which is vaſtly the moſt conſiderable Part of the whole Earth's Superficies. The Longitude and Latitude of Places are here eaſily known by Inſpection, and their Bearing and Diſtances may be nearly eſtimated: And all the Delineations are as accurate and particular as this ſmall Radius would permit. I conceive therefore it may be no unfit Inſtrument for inſtructing Beginners, or for initiating young Minds in the firſt Rudiments of Geography.

FINIS.

ERRATA. Numb. 439. p. 145. l. 15. dele *Mr.* before *Pappus.*
P. 171. l. 4. for *Barrow*, read *William Barlow*,

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Numb. 441.

PHILOSOPHICAL TRANSACTIONS.

For the Months of *April*, *May*, and *June*, 1736.

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ERRATA in *Philoſophical Tranſactions*, No 439.

PAGE 143. line ult. for *it* read *its*, p. 145. l. 15. dele *Mr.* p. 151. l. 13. for CT to CS r. CS to CT. p. 152. l. 24. for HR r. AR. p. 153. l 5. for CF read AF. p. 162. l. 13. for univerſly r. *inverſely.* p. 163. l. 13. for *r m t a* read *r m t v.* p. 164. l. 5. for P S *a* Q r. P S *a v.* l. 6. for P *q* r. P *v*, l. 15. for P R r. P K.

In the FIGURES.

Figure 4. put Q for the Interſection of C F and S K. Fig. 7. let Q be the Interſection of R D and F M. Fig. 2. in pag. 157. for *d* r. Q. Fig. in pag. 160. join N T. Fig. in pag. 163. put B at the Interſection of *t m d* and F D G.

ERRATA in *Philoſophical Tranſactions*, N° 441.

Page 219. line ult. for Seal r. *Scale.*

I. *A Copy of an Ancient* Chirograph, *or* Conveyance *of Part of a* Sepulchre, *cut in Marble, lately brought from* Rome, *and now in the Poſſeſſion of Sir* Hans Sloane, *Bar*ᵗ. *R. S. Pr. with ſome Obſervations upon it by* Roger Gale, *Eſq; V. P. R. & Tr. R. S.*

1 Dijs Manibus
2 Marci Herennij
3 Proti, vixit annos viginti duos
4 Menſes duos, Dies quinque, fecerunt Parentes
5 Marcus Herennius Agricola et
6 Herennia Lacena Filio.
7 Chirographum. Ollaria numero quatuor
8 Cineraria quinquaginta tria intrantibus par-
9 te læva quæ ſunt in monumento
10 Titi Flavij Artemidori, quod eſt Viâ
11 Salariâ in agro Voluſi Baſilides
12 Ientibus ab Urbe parte ſiniſtra, Do-
13 nationis cauſa Mancipio accepit
14 Marcus Herennius Agricola de Tito Flavio
15 Artemidoro Seſtertio nummo Uno, Libripende Marco
16 Herennio Juſto, Anteſtatus eſt Tiberium
17 Julium Erotem: Inque vacuam
18 Poſſeſſionem earum ollarum
19 Et Cinerariorum Titus Flavius Arte-
20 midorus Herennio Agricolæ ire
21 Aut mittere, oſſaque inferre per-
22 miſit, ſacrumque quotiens face-
23 re vellit Herennius Agricola
24 Heredeſve ejus permiſit, Claviſve
25 Ejus monumenti poteſtatem factu-
26 rum ſe dixit, dolumque malum
27 Huic rei abeſſe aſuturumque:
28 Se hæc rectè Dari, fieri præſtari-
29 que ſtipulatus eſt Marcus Herennius
30 Agricola, ſpepondit Titus Flavius
31 Artemidorus. Actum 18° Kalendas Januarij
32 Caio Calpurnio Flacco, Lucio Trebio
33 Germano COS.

THIS Marble, lately arrived from *Rome*, and now repoſited in the noble Muſæum of Sir *Hans Sloane*, is a moſt valuable Piece of Antiquity, as exhibiting a compleat *Formula* of a *Chirograph*, or Conveyance of one Part of a Burying-Place from one Family to another, but neither of them of any Note, ſeeming by their *Agnomina* to have been only *Liberti*, or deſcended from ſuch. *Agricola* indeed is a *Roman* Name, but thoſe of his Wife *Lacena*, and his Son *Protus*, are both *Greek*.

By this *Chirograph* (Line 7th, 8th, *&c.*) *Herennius Agricola* obtains from *Titus Flavius Artemidorus*, a Right to four *Ollaria*, which were *Niches* or *Repoſitories*, wherein they placed *Cineraria*, *Urns*, or *Veſſels* of *Stone*, or *Earth*, containing the Aſhes of the Dead, and were here in Number Fifty-three.

Fabretti[a] indeed takes the *Cineraria* to have been Niches for receiving and keeping *Urnas lapideas*; but *Gutherius de Jure Manium* (Lib. II. c. 24.) tells us, that *Oſſuariæ ollæ à* Cinerarijs *in eo differunt, quod hæ Cineres, illæ oſſa exciperent*. Beſides, if they were Niches, or the ſame as *Ollaria*, the mentioning of them, as in this Inſcription, would be an unintelligible Tautology; and *Spon* (in his *Miſcell. Antiq. Erudit.* p. 290.) gives us the following Inſcription, which ſeems to put the Matter out of Diſpute.

Romæ, in Operculo Vaſis.
CINERARIVM
GEMELL. III. AELI
MARCI. ET PHILIPPI

---

[a] Inſcript. ant. in ædibus pat. p. 16, 17.

From both which Authorities it is evident, that the *Cineraria* were *Vaſa*, and not Repoſitories for them.

This Monument was ſituated on the left Side of the *Via Salaria*, which ran to the North-weſt of *Rome* from the *Porta Collina*. It ſtood in the Ground of *Voluſius Baſilides*, and the Conſideration for the Conveyance of it is one *Seſterce*. It is very uſual in ſepulchral Inſcriptions to find the Monument of one Family in the Field of another, the Proprietor of the Monument reſerving the Right of that to himſelf when he ſold the Ground; or purchaſing ſo much Ground from the Owner as was ſufficient for erecting the Monument. All Sepulchres, when once a Body was interred therein, were eſteemed as Religious and Sacred, and were not to follow the Poſſeſſion of the Field.

Mille pedes in fronte, trecentos cippus in agrum
Hic dabat, Hæredes monumentum ne ſequeretur.
Hor. 1. Sat. 8.

Line 11. *Baſilides* is a Blunder for *Baſilidis* in the Genitive Caſe; and we ſhall meet with more of them before we get through this Inſcription.

Line 11, 12. The Words *Donationis cauſa mancipio accepit M. Herennius Agricola de Tito Flavio Artimedoro* IIS N. I. are to be read *Seſtertio Nummo Uno*, as is evidently demonſtrated from the following Inſcription, where you have alſo the reſt of the Words of this Form of Conveyance. There is likewiſe in *Gruter*[a] an Inſcription, wherein the Words SESTERTIO NUMMO UNO are expreſs'd at length.

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[a] P. DCCCCLVI. 4.

HOC. MONVMENTVM. SIVE
SEPVLCHRVM. CVM. AREA. SVA
T. FVFICIVS. FELIX. DE
IVLIA. RVFINA. DONATIONIS
CAVSA. MANCIPIO. ACCEPIT
ĪĪS. N. VNO. QVOD. COMPARAVIT
FVFICIAE. AMPLIATAE
CONIVGI. CARISSIMAE, &c.

They were *Verba ſolennia Donationis vel Alienationis cauſâ quæ fiebat per Mancipium.* This *Mancipation* was often a fictitious Sale of a thing to make the Donation of it valid, as in this Caſe: And the Mention of one Seſterce given for it, is only *Dicis gratiâ*, much like our Form in Leaſes for putting into Poſſeſſion, *In conſideration of five Shillings in Hand paid.* Frequent Examples occur of this Practice, as in the Inſcription juſt now quoted from *Fabretti*[a], and others in the ſame Author; and in *Gruter* (p. DCCCCLVI. 4. and MLXXXI. 11.) which latter is a compleat *Formula* of a like ſepulchral Conveyance as this, but of a later Time, and not ſo well preſerved; it being executed when the Emperor *Trebonianus Gallus*, and his Son *Voluſianus*, were Conſuls, A. D. 252; and ours probably, as will be ſhewn hereafter, during the Reign of *Septimius Severus*.

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[a] Inſcript. ant. in æd. pat. p. 50.

Line 15.) LIBRJ PENDE is cut in our Marble as two diſtinct Words, as here repreſented, though in reality it ſhould be but one, and ſignifies the Perſon that weighed or counted over the Money to the Seller: It ſhould be read LIBRIPENDE, than whom there could not be a more proper Witneſs to the Purchaſe. At the beginning of the *Roman* State their Money was uncoined, and called *Æs rude*, or *grave*, therefore paid by *Weight*; whence comes the Word *Libripens*. Under *Servius Tullius* their ſixth King, it begun to be coined, and paid by *Tale*; but the Perſon who counted it over to the Receiver, ſtill retained his primitive Appellation. Almoſt every conſiderable Town had its *Libripendes*, Perſons of Skill in Money-Affairs, to determine Controverſies about the Value of it.

An Inſcription in *Gruter* (p. MCXV. 1.) is a ſtrong Evidence of this: It was found at *Nola* in *Campania*, and ſhows they had two *Libripendes* there appointed by publick Authority.

T. VEDIVS. T. F.
T. VITORIVS. CN. F
II. VIRI
LIBRIPENDES
EX. D D.

This Name they had, *Quia libram æneam tenebant quâ nummos penderent*;

—*Libra mercatus & Ære.* Hor. Epiſt. II. 2.

And hence we have the Words *Stipendium*, *Diſpendium*, *Expenſæ*, and the like. In *Apuleius*'s *Metamorph.* Book Xth, is the following Paſſage: ——*Sed ne fortè aliquis, inquam, iſtorum quos offers Aureorum, Nequam vel Adulter reperiatur, in hoc ipſo ſacculo conditos eos annulo tuo prænota, donec altero die* Nummulario *præſente comprobentur*, where this *Nummularius* ſeems to be the ſame as the *Libripens*, who was generally called in to count over and examine the Money at Payments for Purchaſes, though ſometimes a private Perſon or Friend to the Parties might probably perform this Office for them, and be an Evidence, upon Occaſion, to the Facts: To which end alſo they uſed to adhibit another Witneſs, as *Herennius Agricola* does here, who was one *Tiberius Julius Erotes*, and ſometimes they added five more. The Form and Manner of doing it, was by asking a By-ſtander, *Licetne anteſtari*? If he conſented, the Demandant touched, or pulled, the lower Part of his Ear, as a Memorandum of what paſſed; whence *Horace* in his IXth Satire,

> — — *caſu venit obvius illi*
> *Adverſarius, & quo tu turpiſſime? magnâ*
> *Exclamat voce, &* Licet Anteſtari? *ego verò*
> Oppono Auriculam———

By the Law of the XII Tables, if he that was called to teſtify in this manner, or the *Libripens* refuſed afterwards to give his Evidence in the Caſe, they were adjudged infamous. *A. Gel.* l. xv. c. 14.

Line 18.) EARVM OLLARVM ſeems to be a Miſtake for EORVM OLLARIORVM.

Line 20 to 27.) are Covenants uſual upon this Occaſion, as may be ſeen in the like ſepulchral Contracts, particularly the before-mentioned in *Gruter* (p. MLXXXI. 1.) and many other Donations and Orders about Monuments in his voluminous Collection; as alſo in *Fabretti*, and *Reineſius*.

Line 28.) SE ſeems to have been a Blunder of the *Marmorarius* for SIBI, SE DARI being perfectly ungrammatical. But in the Contract aforeſaid, given us by *Gruter*, the Words run, *De ea re dolum malum abeſſe, afuturumque a te, Hærede tuo, & ab his omnibus ad quos ea res pertinebit, hæc* SIC *rectè dari, fieri, præſtarique ſtipulatus eſt*; which inclines me rather to believe, that SE in ours ought likewiſe to have been SIC. There are many palpable Miſtakes in it, as I have before obſerved, as in Line the 23d VELLIT for VELIT, and CLAVISVE for CLAVISQVE, in the 24th.

The *Roman* Lawyers tell us, that *Stipulatio erat Interrogatio certis, ſolennibuſque verbis concepta; & apta, conſentaneaque reſponſio, veluti* ſpondes? ſpondeo. Dabis? Do. This is fully confirmed both in ours, and the *Gruterian* Contract, (p. MLXXXI. 1.) *Stipulatus eſt Marcus Herennius Agricola: Spepondit T. Flavius Artemidorus:* In the latter. *Stipulatus eſt Licinius Timotheus: Spepondit Statia Irene.* The learned Mr. *Mattaire* obſerves from *Aulus Gellius* (Lib. vii. c. 9.) that ancient Authors uſed *e* inſtead of *o*, in thoſe Verbs which have a Reduplication [*in præterito tempore*] as *memordi, pepoſci, ſpepondi*, for *momordi, popoſci, ſpopondi*, uſed by more modern Writers; ſo that SPEPONDIT is no Miſtake, but an Archaiſmus, as may be the Word

IENTIBVS in the 12th Line; though it has not had the good Fortune to have been remarked, as the latter. *Iens* in the Nominative Caſe was uſed more than once by *Cicero*; and though he declines it, like all other Authors now in being, *Euntis*, *Eunti*, &c. yet it might originally have been declined *Ientis*, *Ienti*; but as there is now no Authority extant to warrant it, this muſt paſs as meer Conjecture.

Line 32.) There are no ſuch Names to be found in any of the *Faſti Conſulares* as *C. Calpurnius Flaccus* and *Lucius Trebius Germanus*; ſo they muſt have been not the *Conſules Ordinarij* of the Year, but *Suffecti*. It is very ſtrange that the *Romans* ſhould ſo long adhere to this troubleſome and uncertain Method of Computation by Years of their Conſuls, ſince they had frequently ſeveral Pairs of them in the ſame Year, eſpecially after they fell under the Imperial Government. Some reckoned by the ordinary Conſuls, who came into their Office upon the firſt of *January*, about 600 Years after the building of *Rome*; for 'till that Time the Month of their entring upon that Dignity was not fix'd; and others computed by the *Suffecti*, who might come in ſeveral Months after, as Vacancies happened, or as they were appointed by the Emperor, tho' their Names were ſeldom inſerted in the *Faſti*. Beſides this, it was impoſſible for any Man to remember how many Years were elapſed from the preſent Time upwards, to ſuch and ſuch Conſuls, without Tables of their Succeſſion, or having Recourſe to ſome other Æra, as the A. V. C. *anno Urbis conditæ*, which they do not ſeem to have much regarded.

In *Gruter* (p. XLVI. 9.) is a long Inſcription, mentioning TREBIVS GERMANVS, (though not as Conſul,) in the Reign of *Septimius Severus* ; and another (p. CCCLXXXII. 7.) of C. CALPVRNIVS FLACCVS : If theſe Men were the Conſuls here referred to, as they might be, the Age of our Marble will be aſcertained within a few Years.

The Stone is turned with an Arch at Top ; the whole Length of it is 27 Inches and a half; the Breadth at the Bottom of it is ten Inches and a half, and at the Baſe of the Arch twelve Inches and a quarter, it widening gradually upwards. The Letters are cut in a ſmall indifferent Character; that of the E and the F are remarkable, being always formed in this manner E. *f.*[*] It was probably placed over or between the four *Niches*, or OLLARIA granted to *M. Herennius Agricola* in this Monument by *T. Flavius Artemidorus*, in order to declare and aſſert the Right and Poſſeſſion of them to the former, and his Family, 'till they were all filled.

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[*] *As will appear by examining the engraved Copy of it in the Plate prefixed to this Tranſaction, which is taken very exactly to all the Dimenſions by a Seal of half the original Size.*

II. *Mr.* Stephen Gray, *F. R. S. his laſt Letter to* Granville Wheler, *Eſq; F. R. S. concerning the* Revolutions *which ſmall* pendulous Bodies *will, by* Electricity, *make round larger ones from Weſt to Eaſt as the* Planets *do round the* Sun.

I HAVE lately made ſeveral new Experiments upon the projectile and pendulous Motion of ſmall Bodies by Electricity, by which ſmall Bodies may be made to move about larger ones, either in Circles or Ellipſes, and that either concentrical or excentrical to the Center of the larger Bodies about which they move, ſo as to make many Revolutions about them; and this Motion will be conſtantly the ſame Way that the Planets move about the Sun, *viz.* from the Right to the Left, or from Weſt to Eaſt: But theſe little *Planets*, if I may ſo call them, move much faſter in their *Apogeon*, then in the *Perigeon* Parts of their Orbits; which is, as you very well know, directly contrary to the Motion of the Planets about the Sun. I have not yet communicated theſe Experiments to the Royal Society, being in hopes of making ſome farther Diſcovery, or at leaſt of ſhewing them after ſomewhat more elegant a manner than I make them at preſent, when you may expect to hear a farther Account of them from

S I R,

London, Feb. 6th.
$173\frac{5}{6}$.

Your moſt Obedient
Humble Servant,
Stephen Gray.

III. *Extract of a Letter from Mr.* Joſ. Nic. Del'Iſle, *F.R.S. to* John Machin, *Secr. R. S. & Pr. Aſtr. Greſh. Dated* Petersburg, $\frac{6}{17}$ Feb. 173$\frac{2}{3}$, *containing ſeveral Literary Communications concerning the Conſtruction of a* Quickſilver Thermometer, *and his* Obſervations *on the* Eclipſes of Jupiter's Satellites, Annis 1731, *and* 1732. *Tranſlated from the* French *by* Phil. Henry Zollman. *F. R. S.*

IN order to have more ſure Grounds for my Experiments of Natural Philoſophy in this Country, and that they might be compared with thoſe of other Countries, I applied myſelf this Winter to the Conſtruction of Thermometers of *Mercury*, regulated by the Expanſion of that Fluid proportionably to its bulk. This Expanſion is indeed not very perceptible, conſidering that Dr. *Halley* in the Experiments made by him upon it above 40 Years ago, which are related in *Numb.* 197, of the *Philoſophical Tranſactions*; found, that the ſaid Expanſion, by the Heat of boiling Water, was no more than $\frac{1}{74}$ Part of the bulk of *Mercury*, the Experiment having been tried in the Months of *February* and *March*, when the Weather was cold enough, though it did not freeze.

M. *Amontons*, a Member of the Academy of Sciences at *Paris*, alſo relates in the Memoirs of that Academy of the Year 1704, that this Expanſion of the *Mercury*, is but $\frac{1}{115}$ Part of its Bulk from the greateſt Heat to the greateſt Cold that is felt at *Paris*. For my own part, I found in the great Cold, we had here this Winter on the $\frac{16}{27}$ *January* laſt in the Morning, that the Bulk of the *Mercury* was condenſed almoſt $\frac{1}{50}$ Part of the Extent it had in boiling Water. The Cold we had that Day, the Wind being at Eaſt, was one of the ſevereſt that ever was felt here. I ſhall give you a more exact Account of it hereafter, when I have compared my new Thermometers with thoſe ordinary Ones I made uſe of for theſe four or five Years paſt. My new Thermometers of *Mercury* I had made of a good large Size, and in ſuch Manner that, having divided in each the whole Quantity of *Mercury* it contains into one hundred thouſand Parts; and having mark'd the Extent of the bulk of that *Mercury* in boiling Water, I can at any time ſee on the Diviſions of theſe Thermometers, by how many Parts the Bulk of the *Mercury* is condenſed through the preſent Temperature of the Air. And though I have made four of theſe Thermometers, which differ very much as to their Size, and the Quantity of *Mercury* they contain, yet they agree within a very few of theſe Parts. As pure *Mercury* is of the ſame Nature every where, nor is liable to any alteration from being encloſed in a Tube; and as it is probable, that taking it equally purified, it will in different Countries be ſubject to the ſame Expanſion, if expoſed to the ſame Degree of Heat; for this

Reaſon I am perſuaded theſe Thermometers may very well ſerve to compare the Temperature of different Countries; the rather, as I found by Experience, that theſe Thermometers may be rendered fit enough to mark ſenſibly the Increaſe, or Diminution of the Bulk of the *Mercury*, within one or two Parts out of the 100,000 contained in the whole Bulk. This Sort of Thermometers has alſo this advantage, that as they mark the proper Expanſion of the *Mercury* in each Temperature of Air, they may ſerve to ſhew every Moment the Correction that is to be made in the Height of the *Mercury* in ſimple Barometers; which will ſerve for reducing them to the Height they would have in an equal Temperature of Air: And one might, for this End, chuſe and agree upon the Heat of boiling Water, as a fixed Term, which, in all appearance, will be the ſame all over the World. If the Royal Society ſhould approve this new Conſtruction of Thermometers, and ſhould order ſome of their Members to make the like, we might hereafter be able exactly to compare the Temperature of *England* with that of this Country, and other Places where the like Thermometers ſhould be made. In order to reap this Advantage from my Experiments, I ſhall communicate to the Royal Society all the Obſervations I have made here for theſe four or five Years paſt, on the Barometer and Thermometer, as ſoon as I ſhall have adapted them to the Effect which I juſt now ſaid that Heat and Cold produce upon the *Mercury*. I am informed, that four or five Years ago, the Royal Society ſent to M. *Abraham Vater* at *Wittenberg*, large Thermometers of Spirit of Wine,

made

made and regulated by an Inſtrument-Maker of the Royal Society, in order to compare the Obſervations to be made in *Germany*, by the Means of thoſe Thermometers, with the Obſervations made in *England* by the like Thermometers, the one being regulated by the others. M. *Weidler*, Profeſſor of Mathematicks at *Wittenberg*, mentions in the Account which he gave of his Meteorological Obſervations for the Year 1729, that he has furniſhed himſelf with one, which he intends to make uſe of hereafter for his Meteorological Obſervations. He alſo ſays, that the Obſervers of the Royal Society of *Berlin*, make uſe of a like Thermometer; and I have myſelf received from thence, Obſervations on the Heights of the Thermometer of Spirit of Wine, made probably with that Inſtrument, for the whole Year 1729, and for the firſt three Months of 1731. Thoſe Obſervations are engraved on Copper Plates, where the Heights of the Spirit of Wine are expreſſed in Parts of the *French*, *Engliſh*, and *Rhinland* Foot. If the Royal Society approve of this Sort of Thermometers, and are deſirous I ſhould compare them with mine; if they alſo deſire that Meteorological Obſervations with thoſe Thermometers of Spirit of Wine ſhould be made in *Ruſſia*, I beg you would ſend me ſeveral of them; but then I beg that thoſe you ſend me, be well regulated, and exactly compared with thoſe the Obſervers of the Royal Society make uſe of; ſuppoſing that ſome Perſon or other of their Body is appointed to keep Journals of theſe Obſervations. I ſhall ſend in exchange to the Royal Society, if they deſire it, ſome Thermometers of *Mercury* regulated by and compared with the four large ones which I made here.

It was a great Pleaſure to me, to ſee by N°. 419. of the *Philoſophical Tranſactions*, that Mr. *James Hodgſon* has been at the Pains to calculate the Eclipſes of the four Satellites of *Jupiter*, which were to happen in the Year 1732. It was to be wiſhed he would continue to do ſo for the Years following; but I would adviſe him, to do it a long while beforehand, that People in Foreign Countries might have Time to be informed of it. He ſays, he has made uſe of Tables of the Satellites, which have not been corrected theſe 50 Years. * Probably he means the Tables of M. *Caſſini*, publiſhed at the Royal Printing-Houſe at *Paris*, in 1693, at the End of the Obſervations of the Gentlemen of the Academy made in ſeveral Voyages. However, the late M. *Caſſini*, has from Time to Time made divers Corrections to thoſe Tables, though they never were made publick. M. *Maraldi* has alſo much worked at it after the Death of M. *Caſſini*, and has communicated to me his Corrections, on which I have taken Pains to calculate new Tables; but having in the Year 1724, received of Dr. *Halley* a Copy of his Aſtronomical Tables, among which, are thoſe of the four Satellites of *Jupiter* by Mr. *Bradley*, I judged there could not be any better, till ſome Method ſhall be found and explained geometrically to deduce from the Laws of Gravity, the Effect of the mutual Attraction of theſe Satellites on one another, and with relation to *Ju-*

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* *He means Tables of the late Mr.* Flamſteed.

piter: But as I could not hope this could be done ſo ſoon, I took the Pains again to calculate new Tables upon thoſe of Mr. *Bradley*, by reducing the Tables of the four Satellites into the ſame Form with thoſe Mr. *Pound* has made of the firſt Satellite only. Theſe Tables being thus made eaſy, I have uſed them hitherto for comparing Obſervations; and my Brother has taken the Pains, ſince the drawing up thoſe Tables, in the ſaid Manner, to calculate a Year beforehand all the Eclipſes of the four Satellites. I commonly ſent thoſe Calculations to my Correſpondents, to prepare them for Obſervations, and ſome Years of thoſe Ephemerides have been publiſhed in the *little Gazette of Literature* of *Leipzig*, printed in *High Dutch.* My Brother lately prolonged theſe Calculations to the Month of *January*, 1737.

Herewith follow the laſt Obſervations on the Satellites of *Jupiter*, which were made at *Peterſburg*, ſince thoſe inſerted in the 3d Volume of the Memoirs of the Academy of *Petersburg*, to the preſent Time.

N. St.	True Time.	
1731. *Dec.* 6.	$17^{h}\ 3'\ 5''$	Immerſion of the Firſt Satellite difficultly obſerved with a reflecting Teleſcope of 5 Foot. The true Time was found only by means of two Clocks.
1732. *Jan.* 4.	13 30 56	Immerſion of the Second by the Reflecter, doubtful to a few Seconds. *Jupiter* not being well defined nor ſufficiently high. The true Time adjuſted by two Clocks.
9.	18 33 7	Immerſion of the Fourth by the Reflecter. The Sky not very ſerene, and the true Time adjuſted only by two Clocks.
	20 25 0	The other Satellites diſappearing by the Day-Light, the Fourth was not yet come out of the Shadow. Teleſcope the ſame.

N. St.	*True Time.*	
Feb. 22.	$13^h 25' 34''$	The Firſt Satellite, juſt entring the Shadow, was yet viſible when a Miſt covered *Jupiter.*
	13 26 34	*Jupiter* being uncovered the Firſt Satellite did not now appear through the Reflecting Teleſcope. The true Time was adjuſted only by two Clocks.
March 8.	8 22 20	Immerſion of the Third by the Reflecting Teleſcope. The Wind was ſomewhat troubleſome, the true Time was adjuſted by two Clocks.
April 3.	8 46 23	Emerſion of the Firſt by the Reflecting Teleſcope. Doubtful to a few Seconds, by reaſon of the nearneſs of the Satellite to *Jupiter.*
13.	7 20 30	Immediately after Sunſet, *Jupiter* becoming viſible to the Eye, the Third Satellite appeared to be out of the Shadow,

N. St.	*True Time.*	
April 13.	$7^{h}20'30''$	dow, and entirely clear by the Reflecting Teleſcope.
20.	11 6 52	Emerſion of the Third Satellite, by the Reflecting Teleſcope. The Sky Serene.
27.	15 13 00	The Third Satellite had been come out of the Shadow perhaps for ſeveral Minutes; for the other Satellites did not appear better than this which was ſeen with the Reflecting Teleſcope through the Miſt, *Jupiter* being low, and the *Crepuſculum* ſtrong.
May 10.	12 55 54	Emerſion of the Firſt by the Reflecting Teleſcope. Sky Serene. Obſervation certain.
26.	11 14 5	Emerſion of the Firſt by a Teleſcope of 13 Foot. Cloudy.
Dec. 24.	18 4 30	Immerſion of the 1ſt by a Teleſcope of 13 Foot. A good Obſervation.

IV. Experimenta de *Perforatione Thoracis*, ejuſque in *Reſpiratione Effectibus*, facta per *Guilielmum Houſtonum*, M.D. & quondam R. S. S. cum *Lugduni Batavorum* commoraretur. Ann. 1728 & 1729. Regali Societati communicata per *Philippum Millerum*, R. S. S.

Exp. I.

ANNO 1728, menſe Aprili, Thoracem parvi Canis pugugi ab utroque latere, ſcalpello anguſto. Sed animal, hoc facto, non minus fortiter latravit & ululavit quam prius fecerat; neque ullum dedit ſignum Reſpirationis læſæ; unde ſuſpicabantur adſtantes quidam, me non uſque in cavitatem pectoris inſtrumentum adegiſſe, quare alio vulnerum pari hoc dubium ſuſtuli: ſed ſimili omnino eventu, namque Cani permanſere Vox & Vita integræ, ex horâ 9 matutinâ, ad 6 circiter veſpertinam, quando illum occidi, ut quid factum fuiſſet, viderem.

Thorace poſt mortem aperto, facile apparuerunt quatuor vulnera membranæ ſuccingentis Coſtas, unde conſtitit ſingulas quatuor puncturas in Thoracis cavum penetraſſe. Sed inflatis Pulmonibus, nullum apparuit illorum vitium, quamvis culter fere tranſverſum digitum intra cavitates penetraſſet; neque Aer citius effluxit quam ex Pulmonibus integerrimis effluere ſolet.

Exp. II.

Menſe Auguſto ejuſdem anni, duos nactus Catulos, quatuor circiter dies natos, idem experimentum in utroque inſtitui, Thoraces eorum aperiens ab utroque latere, unius puncturis tantum, alterius latis vulneribus, adeo ut utrinque in conſpectum veniret Pulmo; qui tamen nequaquam ſubſidebat, ſed potius extrorſum protrudi videbatur. Utrumque animal ejulare non deſiit, donec, poſt quadrantem horæ, miſertus illorum vitæ & miſeriis finem impoſui.

Exp. III.

Eodem anno, circa menſis Novembris initium, Cani mediocri pectus aperui, facto utrinque amplo vulnere. Aperturis factis digitum intruſi in utramque Thoracis cavitatem, ſenſique Pulmones adeo collapſos ut ſpatium eſſet relictum tranſverſi circiter pollicis inter ipſos & membranam, quæ ſuccingit Coſtas. Digitos ſuos ſimiliter intruſere duo alii Medicinæ ſtudioſi, idemque ſe ſentire teſtati ſunt. Sed Canis vinculis ſolutus ſurrexit illico ſatis alacriter, per cubiculum cucurrit, & læſus ejulavit. Nullæ aperturis immiſſæ ſunt turundæ, nec quidquam vulneribus impoſitum ante diem craſtinum; tunc autem applicati ſunt plumaceoli terebinthinâ illiniti. Canis per tres dies detentus, adeo non vocem amiſerat, ut vociferando fuerit ſatis moleſtus; & tandem dimiſſus currendo aufugit.

Exp. IV.

Anno 1729, die Januarii 14, Canem nactus juniorem, Thoracem ejus volui aperire Aerique ingreſſum parare, ſine magno Cutis & Muſculorum vulnere; ne moleſtam excitarem hæmorrhagiam, vel animali parerem dolorem non neceſſarium. Itaque, ope inſtrumenti *Trois quarts* dicti, immiſi utrinque Thoracis cavo fiſtulam, ex pennâ anſerina cui capitelli modo affixum erat alutæ fruſtum pice obductum, ut Cuti prius raſæ adhæreret, ſicque fiſtulum retineret. At Cutis mobilis fiſtulam ilico e cavo Thoracis extraxit, ſenſique illam ſupra Coſtas hærere; verum, ſperans eam retineri poſſe, novâ puncturâ ſecundâ vice intruſi, idemque in altero latere toties feci, neque tamen unquam retinere potui. Hac itaque ſpe dejectus, Cutim utrinque ſeparavi longa inciſione, poſteaque Muſculos intercoſtales diſcidi, & in utramque cavitatem Thoracis penetravi; quod ex Aere violenter erumpente patebat. Die craſtino foraminibus turundas immiſi ex ſubere factas, quæ, utroque extremo craſſiores, medio graciliores, nec faſciis nec emplaſtris indigebant ut retinerentur. Canis, hiſce factis, non mortuus eſt, nec vocem amiſit; ſed edit, bibit, & ſatis bene ſe habere viſus eſt, niſi quod vix potuerit in latus recumbere ob moleſtiam vulnerum & præcipue turundarum. Aeri interim ſubinde conceſſus fuit introitus extractis turundis, imo quidem uni lateri per fiſtulam fuit inflatus. Poſtquam ſic duos dies egerat ſine ſenſibili Vocis læſione, dum die tertio ipſe illum tractabam, ſubito utraque turunda ſatis magnâ vi exploſa eſt; Aerque per foramina intrans

trans & exeuns tantum edebat ſibilum, ut ille partim (ut videbatur) ejus ſono perterritus, partim ne ego illum plus læderem metuens, aufugerit & ſub lecto ſe abſconderit. Profugi apprehenſi vulneribus turundas denuo intruſi, quæ haud ita diu poſt iterum exſilierunt. Atque hoc quidem in ſtatu vixit ab hora 10 matutina ad 5 circiter veſpertinam, & a pluribus Medicinæ Studioſis non ſine admiratione viſus eſt. Tandem rem communicavi D. Van Swieten Medico hujus Urbis doctiſſimo, qui rem cum cæteris miratus, animal ut occiderem & cadaver examinarem ſuaſit; ſed ego, vulnerum effectum ulteriorem expectans, mortem ejus in Diem craſtinum diſtuli. Vixit itaque quatuor dies integros poſt Pectoris perforationem, & tandem laqueo ſtrangulatus eſt; neque ſigna dedit Reſpirationis læſæ ante finem diei tertii, quando paululum anheloſus factus eſt.

Thorax poſt mortem apertus Saniem continebat utrinque, ſatis magnâ capiâ. Pulmones in exiguum ſpatium erant contracti; uno latere, quantum videre potuimus, integri; altero vulnerati.

D. Van Swieten, ut in hanc rem ulterius inquireret, ipſe experimenta quædam inſtituit. Primo ejus, ego quamvis invitatus non potui intereſſe; ſed ſecundum (quod vidi) ita ſucceſſit.

Exp. V.

25 Jan. 1729. Cani mediocri, aſſeri alligato, Thorax apertus fuit utrinque, largo vulnere. Animali Vox non defecit; & Pulmones adeo non collapſi ſunt, ut per aperturas eruperit utrinque illorum lobulus. Lobuli hi extus hærentes dilatari & contrahi

non deſierunt; &, quod maxime mirum, dilatatio illorum Thoracis contractioni erat ſynchrona, & contra. Aer in Pectoris cava inflatus Animalis Reſpirationi nihil nocuit. Poſtquam ſic per ſemihoram vixiſſet, ſine ullâ Vocis vel Reſpirationis læſione ſenſibili, Thorax ab uno latere apertus fuit ulterius, diſciſsâ coſtâ. Tumque apparebat (magnum paradoxum!) Pulmonem contrahi dum Pectus dilatabitur, dilatari dum hoc anguſtabatur. Huic etiam operationi ſupervixit Canis, donec, re ab omnibus abunde perſpectâ, laqueo ſtrangulari damnatus eſt.

Phænomena horum experimentorum inexpectata fecerunt, ut ſequens etiam inſtituerem, cum amicis quibuſdam eidem ſtudio incumbentibus, quo examinaremus num Pulmo ſemper applicaretur membranæ Pleuræ, integro Thorace.

Exp. VI.

Canem parvulum, extenſis artubus, firmiter ſuper aſſerem ligavimus. Cutis elevatæ portionem forfice abſcidimus, eâ Thoracis parte quâ Coſtæ ab incumbentibus muſculis minime teguntur. Abſterſo ſanguine, & fluxu ejus Vini ſpiritu cohibito, quicquid adhuc Coſtas & intercoſtales Muſculos tegebat id arreptum tenaculo abſcidimus; tandemque & ipſos intercoſtales Muſculos caute ſeparavimus. Membrana Pleura dicta, hoc modo nudata, hæcce aſpicientibus exhibuit Phænomena. Dum Pectus dilatabatur apparebat intus membranæ applicatum aliquid album, dum vero anguſtabatur Pectus, & expirabat animal, album illud ſurſum fugiens locum ceſſit aſcendenti cuidam corpori rubro; tumque mox dilatante ſe

Pectore, rubrum iterum deſcendit, locum ejus occupante albo; & ſic per vices. Hoc viſo, ſuperius coſtarum interſtitium etiam muſculis nudavimus, ſed eo in loco apparuit nihil niſi album. Membrana, utrâque parte, quâ nudata erat, dum Pectus dilatabatur, fiebat concava; dum anguſtabatur, paululum (ſed vix ſenſibiliter) convexa.

Hiſce ad ſatietatem contemplatis, diſciſſis duabus Coſtis, Pectus aperuimus, tam amplo vulnere ut quicquid fere in eo latere continebatur oculis pateret. Animal hoc facto vocem non amplius edidit, quamvis ab altero latere Thorax ejus eſſet illæſus. Pulmo multum ilico collapſus eſt; ſed alternum dilatationis & contractionis motum non penitus amiſit: eratque, omnium aſpicientium conſenſu, dilatatio ejus contractioni Thoracis ſynchrona, & contra. Cordis tandem ventriculus pertuſus eſt, ut intruſus digitus ſentiret vim ejus muſcularem; ſicque de Reſpiratione ſimul & Vita actum eſt.

Fueram ego prius in ea opinione quod Homo, vel aliud animal ex perfectioribus (nam Ranarum & ſimilium alia ratio eſt) non poſſet vivere ſi Aër in utramque cavitatem Thoracis admitteretur. At quam ſit falſa hæc opinio, ſatis docent experimenta recenſita; ſimulque repugnare videntur doctrinæ Reſpirationis ab omnibus merito receptæ, quæ ſtatuit Pulmones dilatari a pondere Aëris per Laryngem intrantis, quando preſſio ejus ab externa illorum ſuperficie tollitur dilatatione Thoracis. Verum hanc apparentem repugnantiam ſic tolli, vel ſaltem minui, poſſe exiſtimo.

Supponamus utrumque vulnus duplum eſſe aperturæ Glottidis; ſed integros eſſe Pulmones, omnique vi contractili deſtitutos. Sitque Thorax jam dilatatus, & à Pulmonibus Aëre diſtentis repletus, tum

1. Prima Thoracis contractione, exibit Aër per ſolam Glottidem.

2. Dilatato iterum Thorace, intrabit Aër, eâ menſurâ, quâ ejus capacitas augetur; ſed non omnis intrabit per Glottidem, neque omnis per Vulnera, ſed per ſingulas aperturas intrabit pro ratione earundem; & quantitas, quæ per Glottidem intrabit, erit ad quantitatem quæ per Vulnera intrabit, ut Glottidis ipſius apertura, ad ſummam aperturarum Vulnerum; ſive in preſenti caſu ut 1. ad 4. Ergo Aër quo Pulmones nunc inflantur, erit $\frac{1}{5}$ illius quo fuiſſent inflati ſi Thorax manſiſſet integer.

3. Dum ſecundâ vice contrahitur Thorax, debet Aër per eaſdem vias egredi per quas in præcedente dilatatione eſt ingreſſus: &, ſi immutatæ manent aperturæ, debet Aër, qui per vulnera ingreſſus eſt, per eadem exire eodem præciſe tempore, quo Aër per Glottidem ingreſſus per illam exit. Unde nullus Aër manebit inter Pulmonem & Pleuram, ſed omnia erunt in eodem ſtatu in quo fuerunt in fine primæ contractionis; & ſi ad vitam & vocem Animalis ſufficit $\frac{1}{5}$ ſolitæ inflationis Pulmonum, vel ſi Thoracem poteſt dilatare quinquies plus ſolito, tunc nihil obſtat quin aperto ſic Thorace poſſit vivere & vocem formare.

Unum ſuppoſui plane falſum, Pulmonem omni vi contractili deſtitutum eſſe; quod omnia everteret niſi daretur aliunde compenſatio. Verum conſtat Glottidis rimam pro arbitrio animalis arctari poſſe vel dilatari, & quidem actu dilatari, dum inſpiratur Aër, arctari vero dum expiratur, (ſaltem dum Vox formatur); unde tantum poteſt Aëris ingreſſus juvari à Glottidis dilatatione, quantum, impeditur a Pulmonum vi contractili; tantumque ejus egreſſus impediri à Glottidis arctatione, quantum a contractione Pulmonum juvatur. Poteritque æquilibrium ſervari, vel una alterave cauſa prævalere, prout animal hanc poteſtatem mutandi Glottidem habuerit, vel eadem uſus fuerit. Quod etiam cum Phænomenis apprime convenit; nam cani vociferanti Pulmones per Vulnera erupere; dum ſilebat, iterum introiverunt, nec eruperunt unquam.

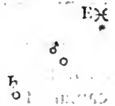
Quod ad illud Phænomenon attinet quo Pulmo viſus eſt dilatari dum Thorax contrahebatur, credo illud non aliam ob cauſam ſic accidiſſe quam quia muſculi Abdominis vi ingenti, & quaſi convulſivâ, contracti ſurſum pellebant omnia, & multum minuebant Thoracis capacitatem; unde Aër ex inferioribus Pulmonum pulſus ad ſuperiora tendebat, & Pulvis quamvis, ſi totum ſpectes contractus, tamen eâ parte quâ vulnus reſpiciebat dilatabatur.

In ſexto Exp. res ipſa loquitur, album Corpus Pulmonem fuiſſe, rubrum Diaphragma. Quin & Pulmones Thoracem integrum replere, ejuſque membranæ ſuperficie ſuâ applicari, ut vulgo creditur.

Reſtant autem hac in re difficultates aliæ, accuratioribus experimentis & acutioribus ingeniis tollendæ.

V. Obſervationes *nonnullæ ſingulares* Anni CIↃIↃCCXXXIII. *tam* Aſtronomicæ, *quam* Phyſicæ, & Meteorologicæ, *ab* Joh. Frid. Weidlero, *Prof. Math. Pr. R. S. S. Vitembergæ factæ.*

1. OBſervatio conjunctionis Saturni & Martis. Die 5 Febr. veſperi Hor. 7 m. 30, viſi ſunt duo illi planetæ cum ſtella E ♓ Beieri in eadem recta linea.



♄ ♂ 2° 15′.
♂ E♓ 1, 12. 30″.

2. Die 19 Febr. veſperi h. 7. 15′. notata fuit diſtantia ♂ ab ο♓, nempe ο♓ ♂ 1° 17′ 30″. Mars diſtabat à ſtella verſus Septentrionem.

3. Lenitas hiemis præcedentis Menſibus Febr. & Martii febres catarrhales epidemicas peperit.

4. Menſis Martii d. 14. frigus ſolito aſperius, quod illo die experti fuimus, ventus N. E. duos ante dies impetuoſiſſimus attulit.

5. Obſervatio Eclipſis Solaris die. 2 Maii St. V. facta ſeparatim Inclutæ Regiæ Societati oblata fuit & in Tranſ. No 233, invenienda eſt.

6. Maii die. 3. Dicitur *Aurora Borealis* luxiſſe.

7 Maii die 5. frigus nocturnum vites laeſit & juglandes etiam ſegetes paſſim locis maxime humilioribus exuſſit, ut ſpicæ poſtea granis carerent.

8. Junii die 26. veſperi *Aurora Borealis* luxit, & ſolitas pyramides circa h. 12 noctis ejaculata eſt.

9. Octobris die 27. iterum luxit *Aurora Borealis.* Veſperi illius diei circa Hor. 7. arcus niger, alba faſcia tectus, ſub ſeptemtrionibus apparebat. hor. VIII. 30′. Zona candida nigro arcui incumbens ſenſim altius expandebatur, circiter uſque ad altitudinis gradum 40. atque hæc regio lucida tranquilla uſque ad hor. X permanebat. poſt hor. X. paſſim ex tractu candido radiationes pyramidales, celeriter emicabant, nebulæ quoque undarum inſtar per cœlos provoluebantur, quin viſus aliquando eſt totus margo candidus inſtar undæ lucidæ verſus polum aſſurgere. Hæc undulatio materiæ lucentis, permiſtis ſubinde radiis pyramidalibus, lucida illa regione multo clarioribus, durabat uſque ad hor. XI. tota materia lucida ſenſim paulatimque verſus ortum promovebatur, in cujus locum nubes atræ diſtractæ verſus occaſum ſuccedebant. Paulo ante hor. XI. prope N. W. nubes alba diutius lucebat, & ſubinde rubebat, materia quoque ejuſdem undulabat. ceſſavit ſpectaculum poſt h. XI. aër tempore apparitionis tranquillus paſſim quoque Stellæ per candidam regionem tranſlucebant; Notabile mihi viſum eſt, quod die proxime ſequente cœlum caliginoſum & pluvioſum fuerit, item quod Noctu poſt diem XXIX ventus longe impetuoſiſſimus & procelloſus ſævierit, cum aliás poſt auroras boreales inſigniores ſerenior plerumque tempeſtas ſequi ſoleat.

Idem Auroræ borealis phænomenon etiam Stockholmii in Suecia annotatum fuit.

An.

VI. *An Extract of a Letter from* James Logan, *Eſq; to Sir* Hans Sloane, *Bart. R. S. Pr. concerning the crooked and angular Appearance of the* Streaks, *or* Darts *of* Light'ning *in Thunder-Storms.*

Philadelphia, Sept. 20, 1735.

I Shall crave thy Indulgence further to add, that looking into the Second Volume of that ingenious Gentleman *Stephen Hales*'s Staticks, of which I have lately happened to have a curſory View, I obſerved him to mention that Phænomenon of the Streaks or Darts of Light'ning in Thunder-Storms appearing crooked and angular (I do not remember his Words) as a thing not yet accounted for; and therefore he gueſſed at a Solution of it*.

The Clouds are generally diſtinct Collections of Vapours like Fleeces, and therefore the Rays of Light thro' them muſt paſs thro' very different Denſities, and accordingly ſuffer very great Refractions: From thence therefore, undoubtedly, that Appearance muſt ariſe. For it is moſt highly abſurd to imagine, that Fire darted with ſuch a Rapidity, can from any aſſignable Cauſe deviate in Fact from a Right Line, in the Manner it appears to us. And this, if duely conſidered, may probably be found a plenary Solution.

* *See* Steph. Hales's *Statical Eſſays* Vol. 2d. p. 291.

VII. *Obſervations of the* Aurora Borealis *made in* England *by* Andr. Celſius, *F. R. S. and Secr. R S. of* Upſal *in* Sweden.

SEPT. 13, 1735, in the Town of *Woodford*, ſix Miles to the North Eaſt of *London*, at 11 ½ h. at Night, there appear'd a bright Band, almoſt parallel to the Horizon; and its Middle was judged to be under η of the Great Bear. At Times another Light ſhot along the Great Bear; but almoſt conſtantly cover'd the Stars γ and δ.

Octob. 4, in *King-ſtreet, Bloomsbury,*

	h	'	''	
At	9	22	0	p. m. A Ray or Streamof Light appear'd under the Polar Star perpendicular to the Horizon.
	9	24	13	That Ray diſappear'd.
	9	27	6	Two perpendicular Rays ſhot forth five or ſix Degrees from the North towards the Eaſt.
	9	28	30	A whitiſh Ray again exactly under the Polar Star.
	9	30	0	That Ray moved Weſtward.
	9	31	0	'Twas ſeen under η of the Great Bear.
	9	31	27	It entirely diſappear'd.
	9	36	8	A Ray aſcending perpendicularly by the Polar Star, and α and β of the Great Bear.
	9	40	0	The Ray ſeem'd to move gradually under ξ of the Great Bear.

No

h ′ ″
At 9 44 0 No more Rays appeared. But
whether there were any Remains of Light near the Horizon, or in the Weſt, I could
not ſee, upon account of the
neighbouring Houſes.

Octob. 11, in *London*.

h ′
At 10 37 p. m. There were two bright Rays
under ζ and ε of the Great Bear.
10 39 A Ray between ε of the Great
Bear and the Polar Star.
10 39½ A Ray in Form of a Pyramid above η of the Great Bear.
Theſe Rays had not any Motion
parallel to the Horizon; but they
10 43 entirely diſappear'd.

Jan. 11, 173$\frac{5}{6}$ in *London*.

At 10. 0. p. m. An indifferently bright Arch,
pale towards the Edges, appear'd
16 Degrees high: One of the
Ends of which deſcended Eaſtward under η of the Great Bear:
And lucid Streaks appear'd now
and then over this Arch.
11 13 Under this Arch was another very
bright Tract parallel to it, five Degrees above the Horizon; in which
Tract there were Rays, that ſhot
from Weſt towards the Eaſt.
11 15 This Arch was very faint.

The

h ′ The firſt Arch became brighter,
At 11 17 and the lower Arch was almoſt blended with the upper, and broken in the middle.

11 20 The whole Arch was beſet with faint Rays.

11 21 One of the Rays under the Polar Star.

11 27 No Arch, nor Rays, but bright Tracts diſperſed here and there.

11 36 The Light reached up to the Polar Star, and ſomewhat higher.

11 44 A lucid Ray under the Polar Star.

12 11 The Sky was overcaſt with Clouds, except one lucid Streak, which appear'd three or four Degrees to the Eaſt of the North.

February 16, in *Clare-Hall, Cambridge*,

At a Quarter paſt Eight in the Evening, the Moon ſhining very bright, there appear'd two perpendicular Streams betweenthe great and little Bear

April 3, in *London*,

h ′
At 8 46 I obſerved a lucid Arch one Degree broad, which extended along the Northern Crown, the *Cingulum Boötis*, the *Coma Berenices*, the

leſſer

leſſer Lion and Cancer, as far as the ſmaller Dog.

h ′ ″
At 8 49 36. This Arch quite diſappear'd: But at the ſame time, I ſaw another broader and brighter Arch under *Caſſiopea*, ſeven or eight Degrees high.

In the Obſervations of *October* 4th, and in the laſt, I am certain as to the Time of the Clock: So that if it has happen'd that others have obſerved the ſame *Phænomena*, the Longitudes of Places may be determined by them with greater Exactneſs than by the Satellites of *Jupiter*, which I take to be the principal Uſe that may be made of theſe Obſervations, eſpecially in making Maps of the Northern Countries, where theſe Lights more frequently occur.

VIII. *A Letter from Dr.* Robert James, *of* Lichfield, *to Sir* Hans Sloane, *Bart. Pr. R. S. containing ſome Experiments made upon* Mad Dogs *with* Mercury.

Lichfield, June 3, 1735.

SIR,

IN purſuance of your Commands, I here give you an Account of ſome Experiments that have been made upon *Mad Dogs* with *Mercury*, which I apprehend I have ſome Reaſon to believe is the moſt effectual Preſervative againſt, and perhaps even a Cure for the *Hydrophobia*.

About *Michaelmas*, 1731, I waited on Mr. *Floyer*, of *Hints*, a Gentleman who is very curious in Fox-Hounds. He complain'd that He was afraid of a Madneſs amongſt his Hounds; for that Morning one had run mad in the Kennel, and he was apprehenſive that moſt of the reſt were bit by him: I took this Opportunity of telling him that I had long believ'd that *Mercury* would, if try'd, prove the beſt Remedy againſt this Infection; and that if the Idea I had form'd of this Poiſon was juſt, I was pretty ſure the Medicine would anſwer, notwithſtanding the Difficulty there is of determining the Effects of a Medicine *à priori*; and that it was, at leaſt, worth while to try. Mr. *Floyer* neglected this Advice till the *February* following. Mean time he try'd the Medicine in *Bates*, commonly known by the Name of the Pewter-Medicine; as alſo every thing elſe which was recommended to him by other Sportſmen, but to no Purpoſe; for ſome of his Hounds run mad almoſt every Day after Hunting. Upon this he took his Hounds to the Sea, and had every one of them dipt in the Salt-Water; and at his Return, brought his Pack to another Gentleman's Kennel, ſix Miles diſtant from his own. But, notwithſtanding this Precaution, he loſt ſix or ſeven Couple of his Dogs in a Fortnights Time. About this Time, which was in *February*, I waited on him at his new Habitation, and found him in that Diſtreſs not unuſual with Sportſmen upon theſe Occaſions. I ask'd him if he had try'd the Experiment I recommended. He ſaid he had

not,

not, but that two of his Hounds were then mad, and he would that Night do it. He ſhewed me the Dogs, and they were both as far gone as I ever have ſeen any. They refus'd Food of all Sorts, particularly Fluids, ſlaver'd much, and had all the Symptoms of a *Hydrophobia* to a great Degree. He ſent immediately to *Lichfield* for all the *Turpeth Mineral* he could get, and that Night gave twelve Grains a-piece to the two Dogs, which vomited and purged them gently. Twenty-four Hours after this he gave to each twenty-four Grains, and after the ſame Interval he gave forty-eight more to each. The Dogs ſalivated conſiderably, and ſoon after lap'd warm Milk. At the End of twenty-four Hours more he repeated to one Dog twenty-four Grains more, and omitted it to the other. The Dog that took this laſt Doſe, lay upon the Ground ſalivated extreamly, was in great Agonies, and had all the Symptoms of a Salivation rais'd too quick; but got through it, and is at this Time alive. The other relapſed and died.

To all the reſt of the Pack he gave ſeven Grains of the *Turpeth* for the firſt Doſe, the ſecond twelve, at twenty-four Hours diſtance, which was repeated every other Day for ſome little Time. The Method was repeated at the two or three ſucceeding Fulls and Changes of the Moon. From this Time he loſt not another Hound; and though ſeveral have ſince been bit by ſtrange Dogs, the *Turpeth* has always prevented any ill Conſequences.

I and my Friends have try'd the ſame Thing ſince upon a Multitude of Dogs, and it has never failed in any one Inſtance, though Dogs bit at the ſame

Time, and by the ſame Dogs, have run mad after moſt other Methods had been try'd.

As to the Experiments made upon Mankind, I have had Opportunities of making but three.

The firſt was about two Years and a half ago, upon a Girl about fourteen Years old. The Calf of her Leg was ſo torn by a Mad Dog, that the Surgeon was obliged to uſe Means to prevent a Mortification from the Bite. She was vomited by the *Turpeth*. Three Days before the next Change of the Moon, the Vomit was repeated, and again the very Day of its changing. The ſame Method was purſued the next Full Moon. The Girl is very well.

The ſecond was a Boy of about ten Years of Age. He had Four Holes in one of his Legs, made by a Mad Dog in *November* laſt. The *Turpeth* was given as above, and the Wounds dreſſed with Digeſtives, and he continues well. Theſe two liv'd near *Burton* upon *Trent*, and Mr. *Towndrow*, of that Place, was Apothecary.

The third Caſe was that of a young Man near *Tamworth*, of about eighteen. The Bite was upon the Hand. A great Number of Dogs were bit at the ſame Time, in the Town where he liv'd. About ſix Days after the Miſchief was done, ſeveral Dogs that had been wounded ran mad, upon which he applied himſelf to Mr. *Wilſon*, Apothecary in *Tamworth*, to whom I had communicated the Succeſs of the *Turpeth* in this Caſe. The young Man was, at this Time, very melancholly and dejected, had Tremors, and ſlept very little for ſome Nights before, though he was not apprehenſive that the Dog which bit him was mad. He had a dry Scab upon his Hand: He was, upon applying to Mr. *Wilſon*, vomited with *Vin. Benedict.* ℥ij.

The next Thing he took was made according to the following Preſcription.

℞ *Turpeth. Min.* gr. xij. *Lap. Contrayerv.* ʒi. *Ther. Androm. q. ſ. M. F. Bol.* N° 3; *ſumat unum ſingulis noctibus hora decubitûs ſuperbibendo Julap. ſeq. Cochl.* iv. ℞ *Aq. Rut.* ℥vj. *Theriac.* ʒij. *Syr. Pæon.* c. ℥iß *Tinct. Caſtor* ʒij *M. F. Julap.*

Upon taking theſe he ſweat very much, and had two looſe Stools every Day after them: His Tremors went off, and ſlept better. After this he went into the Cold-Bath, and continues perfectly well.

But what is remarkable in this Caſe is, that the Wound ran a thick digeſted Matter after this Method, and threw off the Scab like an *Eſcar*; after which it healed of itſelf.

I will not preſume to philoſophize upon theſe Caſes, when I am writing to one who is ſo much better capable of doing it than I can pretend to be. Much leſs ſhall I pretend to determine whether *Mercury* has theſe Effects from its ſpecifick Properties, which enables it to prevent or diſſolve thoſe inflammatory Concretions which cauſe the *Hydrophobia*, or from the Evacuations it cauſes. Inſtead of diſcuſſing this Point, give me leave to make an Obſervation or two upon the Antiquity of this Diſeaſe, which I the rather chooſe to do, becauſe *Cælius Aurelianus*, in his Account of it, does not ſeem to build ſo much upon the Authority of *Homer* as, in my humble Opinion, he might have done. Indeed he quotes a Paſſage out of the eighth

Iliad, where *Teucer* calls *Hector* κύνα λυσσητῆρα, but does not ſeem to think this ſufficient to prove that *Homer* was acquainted with this Madneſs. But he omits two more Paſſages in the ſame Author, which, joined with this, amount to a Demonſtration that *Homer* was by no means ignorant of it. The firſt is in the ninth *Iliad*, where *Ulyſſes* is upon his Embaſſy to *Achilles*. He deſcribes to the laſt mentioned Hero, the Diſtreſs the *Grecian* Army was in through his Abſence; and when he has painted *Hector* as terrible as he can, he compares his Fury to the Rage of a Mad Dog. *Iliad* Lib. ix. l. 237.

——Ἕκτωρ δὲ μέγα σθένεϊ βλεμεαίνων
Μαίνεται ἐκπάγλως, πίσυνος Διΐ, οὐδέ τι τίει
Ἀνέρας οὐδὲ Θεούς· κρατερὴ δὲ ἑ λύσσα δέδυκεν.

——Hector *verò valde trucibus oculis adſpiciens*
Furit terribiliter, fretus Jove: *nec quicquam honorat*
Viros neque Deos; ingens autem ipſum rabies invaſit.

If *Homer* had deſign'd to deſcribe a Mad Dog as a Phyſician, he could not have expreſs'd his Looks by a more proper Word than Βλεμεαίνων. It muſt alſo be conſider'd, that this Diſcourſe is directed to *Achilles*, who, having ſtudied Phyſick under *Chiron*, was conſequently more capable of receiving an Idea of the Miſchief *Hector* did to his Country-men by this Metaphor.

In the thirteenth *Iliad*, *Hector* is again call'd Λυσσώδης, by *Neptune*.

It muſt be obſerv'd that λύσσα, λυσσητὴρ, and λυσσώδης, can properly, and in their natural Signification,

cation, be applied to no other Madneſs than that which is peculiar to a Dog, though metaphorically it may, as in the Inſtances I have given, as alſo in *Sophoclis* and *Euripides*. The Word λύσσα or λύττα is uſed to ſignify the Madneſs of Dogs by *Ariſtotle*, *Galen*, and *Dioſcorides*. And Λυσσόδηκτος is uſed by the laſt mentioned Author to ſignify a Man bit by a Mad Dog. Λυσσάω is uſed by *Aretæus* in this Senſe, and Λυττώσαις by *Plutarch*, to expreſs the ſame Thing.

What I would infer from this is, that *Homer* was certainly acquainted with the Madneſs of Dogs; and if Dogs in his Days ran mad, 'tis probable they would bite Men, and if ſo, to be ſure, an *Hydrophobia* would be the Conſequence; notwithſtanding that, *Plutarch* will have it that it was firſt taken Notice of in the Days of *Aſclepiades*, who was famous for his Practice in *Rome* before the Death of *Mithridates*.

Another ſtrong Evidence of its Antiquity is that Inſtinct which directs every Dog to avoid him that is mad, upon ſmelling, ſeeing, or even hearing him. If this is not Inſtinct, it is Reaſon; and that in a higher Degree than we ourſelves can pretend to. Now Inſtinct muſt be coeval with the Creation, or at leaſt the Fall; and therefore Madneſs muſt not be much younger.

I heartily ask Pardon for taking up ſo much of your Time from Buſineſs of much greater Import; and I beg Leave to ſubſcribe myſelf,

SIR,

Your moſt obedient humble Servant,

ROBERT JAMES.

IX. *A Continuation of an Account of an Eſſay towards a* Natural Hiſtory *of* Carolina *and the* Bahama *Iſlands. By* Mark Catesby, *F. R. S. with ſome Extracts out of the* Eighth *Set. By Dr.* Mortimer, *Secr. R. S.*

AN Account of the preceeding Set is printed in N° 438. of theſe *Tranſactions.* Our Author begins this eighth Set with the forty-firſt Plate of his Second Volume; and, as in this Set he treats chiefly of Serpents, he hath, by way of Introduction, given a ſhort Account of the Serpents in general of theſe Countries: He ſaith, that in *Carolina* he hath ſeen about 18 Sorts of Serpents, whereof only four are of the Viper Kind, the others of the Snake Kind. Beſides the different Manner in which Vipers and Snakes produce their young, he gives ſome external Marks whereby, at firſt Sight, one may judge to which of the two Sorts any Serpent belongs. Vipers have long hollow Fangs or Tusks, with an Opening near the Point through which they emit their Venom when they bite; theſe Fangs are articulated to the Jaw, and lie flat when the Viper is not provoked, or hath no Intention to bite; for though his Jaws are full of ſmall Teeth, they do not ſeem intended for chewing, but only as ſo many Beards, like thoſe on a Fiſh-hook or Arrow, to prevent their Prey, when any Part of it is in their Mouth, from getting back again. Vipers are of an ugly terrible Aſpect, their Heads are broad, and their Cheeks wide, their Necks ſmall, but when irritated they can ſwell them out; their Bodies are, in proportion, ſhorter and thicker, their Scales rougher, and they are ſlower of Motion. Snakes are of a pleaſant, harmleſs Aſpect, their Heads ſmall, and Necks as thick as the Head, their Bodies long and ſlender, their Scales ſmooth, and they are nimbler of Motion; their Jaws are full of ſmall Teeth, the ſame as the Viper's, excepting the Tusks. The Tongues of both Sorts are a-like, being forked, which Form is the beſt for catching Inſects, on which they both feed as well as on larger Animals.

Our Author begins his firſt Plate of this Set, with the Figure of the

41. *Vipera caudiſona Americana:* The Rattle-Snake. Our Author ſaith, that this Species is the largeſt, and therefore the moſt venemous of any of the Viper Kind; the largeſt he ever ſaw was of 8 Feet, and weighed 8 or 9 Pounds. They often come into Yards, where they put all the Domeſtick Animals in great Conſternation, nay, ſometimes, they get into the very Houſes, and one was found between the Sheets in a Bed ſoon after the Perſon had left it. Nothing hath yet been found as a certain Cure for the Bite of this horrible Creature; cutting out the Fleſh were the Wound is, and ſearing it, ſeems to be the ſureſt Method. He ſaith, the Charming of other Creatures, attributed to this Snake, is generally believed in *America*; but I ſhall ſay nothing more of it here, referring the curious Reader to the Account our learned Preſident, Sir *Hans Sloane*, hath communicated to this *Society*, on that Head, in *Tranſactions*, N° 433.

Not having before met with ſo particular a Deſcription of the Rattle, which this Sort of Vipers carries at their Tails, I ſhall tranſcribe his Words. "The Rattle is of a brown Colour, compoſed of "ſeveral horney membranous Cells of an undulated "pyramidal Figure, which are articulated one with- "in the other, ſo that the Point of the firſt Cell "reaches as far as the Baſis, or protuberant Ring "of the third, and ſo on; which Articulation be- "ing very looſe, gives Liberty to the Parts of the "Cells, that are incloſed within the outward Rings, "to ſtrike againſt the Sides of them, and ſo to cauſe "the rattling Noiſe, which is heard when the "Snake ſhakes its Tail. In the Plate is delineated "the Section of one of theſe Rattles, and likewiſe "one of them entire with 24 Joints; and on the "other Side is a large Fang or Tusk."

42. *Vipera caudiſona Americana minor:* The ſmall Rattle-Snake. Our Author is not certain whether this be of a different Species from the preceeding; its Difference of Size and Colour being poſſibly owing to Difference of Age, and the Change of its *Exuviæ*; for he ſays, that he hath often obſerved that the ſame Snake, on changing its Skin, hath been of very different Colours from what it was before. He thinks it to be a Miſtake, that Rattle-Snakes have as many Joints in their Rattles, as they are Years old. To this Serpent are joined the Figures of two Plants.

Frutex, foliis oblongis ſerratis alternis; Acaciæ floribus luteis; fructu brevi, calyculato viridi.

Acacia, Buxi foliis rotundioribus; floribus albis; ſiliqua lata compreſſa. This Tree affords an excellent Wood for Joyners Work. It is, miſtakenly, called *Mahogany* by the *Bahamans*; it is next in Beauty to what is here called *Madera*, which is the *Mahogany* of *Jamaica.*

43. *Vipera Aquatica*: The Water-Viper. Theſe Serpents are commonly found hanging on Branches of Trees, which lean over Rivers, into which they plunge after Fiſh, which they catch and carry to Shoar. This Sort is commonly called in *Carolina*, the Water Rattle-Snake, not that it hath a Rattle, but from the Likeneſs of its Colour, and its Bite being as mortal. Its Tail terminates in a ſharp pointed Horn, which, by the credulous, is thought likewiſe to be venomous, and that a Tree wounded with it will die; but this is without Foundation.

Frutex, foliis ſerratis, floribus longioribus ſpicatis ſubviridibus, capſula pentagona.

44. *Vipera nigra*: The black Viper.

Arbor foliis pinnatis, ſpica pendula ſericea, Alpin. p. 2.

45. *Vipera fuſca*: The brown Viper in *Virginia*: In *Carolina* it is called the *Truncheon-Snake*.

Arum maximum Ægyptiacum quod vulgò *Colocaſia* C. Bauh. pin. p. 195. *Sloane* Hiſt. *Jamaic.* Vol. I. p. 166. *Arum Ægyptiacum* F. Column. *Ecphras.* Part II. p. 1.

Our Author refers his Readers to Sir *Hans Sloane*'s ample Deſcription of this uſeful Plant, in his *Natural Hiſtory of* Jamaica, Vol. I. p. 166. to which he only adds, that they are very acrimonious till boiled 8 or 9 Hours, and then become eatable, and taſte much like common *Potatoes*. There is ſince introduced into *Carolina*, another Sort which is not acrimonious, but may be eat even raw; theſe Roots are here the chief Food of the Slaves; they come originally from *Africa*.

46. *Anguis, Ventre Cuprei coloris:* The Copper-bellied Snake.

An Ricinoïdes Æleagni folio? The *Ilathera* Bark. The Bark of this Tree being burnt, yields a fine Perfume; infuſed either in Wine or Water, it gives a grateful aromatick Bitter. This is called *Cortex Eleutheriæ* by others; taking its Name from one of the *Bahama* Iſlands, corruptly called *Ilathera* inſtead of *Eleutheria*, or *Liberty-Iſland*, from the *Greek* Word ελευθερος, *liber*, free.

47. *Anguis gracilis, cæruleo-viridis:* The bluiſh-green Snake. It is found chiefly on Trees.

Frutex baccifer, verticillatus; foliis ſcabris, latis dentatis, & conjugatis; baccis purpureis, denſé congeſtis.

48. *Anguis niger:* The black Snake. Theſe Snakes are very beneficial in killing Rats, which they purſue in all Parts of Buildings.

Frutex, Rubo ſimilis, non ſpinoſus, capreolatus; fructu racemoſo, cæruleo, Mori-formi.

49. *Anguis minor fuſcus maculatus:* The little brown Snake. Theſe Snakes generally live under Ground.

Corallo-dendron humile; ſpica florum longiſſima, coccinea; radice craſſiſſima.

50. *Anguis gracilis, fuſcus:* The Ribbon-Snake.

Arbor baccifera, Laurifolia, aromatica, fructu viridi, calyculato, racemoſo. Sloane's Hiſt. *Jam.* Vol. II. p. 87. *Cortex Winteranus* Offic. Winter's Bark. Our Author agrees with Sir *Hans Sloane*, that this is not the true *Winter*'s *Bark*, altho' it hath obtain'd the Name, and is uſed as ſuch.

51. *Anguis gracilis maculatus:* The ſpotted Ribbon-Snake.

Pſeudo-ſantalum, croceum. Sloane's Hiſt. *Jam.* Vol. II. p. 184. Braſiletto. This Wood is uſed in Dying, but the Demand for it having been great, the *Bahama* Iſlands are almoſt clear'd of it.

Flos Paſſionis minimus, trilobatus; flore ſubcæruleo.

52. *Anguis annulatus:* The Chain-Snake.

Frutex, Lauri longiore folio.

53. *Anguis viridis maculatus:* The green ſpotted Snake. The Author doubts whether this is not the ſame with the ſpotted Ribbon-Snake, p. 51.

Apocynum ſcandens; ſalicis folio; flore amplo, pleno.

54. *Anguis Flagelli-formis:* The Coach-whip Snake; ſo called from its being very long and ſlender like a Coach-whip. The *Indians* fooliſhly believe that one of theſe Snakes can, with a Jerk of its Tail, cut a Man aſunder.

Lychnis viſcoſa Virginiana ; *flore amplo, coccineo* ; *ſeu Muſcipula Regia*. D. Baniſter Phytograh. Tab. 203. Fig. 1.

55. *Anguis è rubro & albo varius* : The Corn-Snake. This takes its Name from the Reſemblance of its Colour to that of *Maize* or *Indian* Corn.

Viſcum Caryophylloides ramoſum ; *floribus minimis albis*. This is a Bulbous Plant, like a *Narciſſus*, and grows ſometimes on the bare Rocks in the *Bahama* Iſlands ; but being moſt commonly a *Paraſite* Plant, the Author hath given it the Name of *Viſcum*.

56. *Anguis capite Viperino* : The Hog-Noſe Snake. The Author ſuſpects this to be of the Viper Kind, altho' in one of them he could find no Fangs.

Lilium, *ſive* Martagon *Canadenſe* ; *flore luteo, punctato*. Acad. Reg. *Pariſ.* The *Martagon*. The Plate exhibits the Flowers of two Sorts ; the largeſt of which is growing in Mr. *Collinſon*'s Garden.

57. *Anguis viridis* : The green Snake.

Caſſena vera Floridanorum ; *Arbuſcula baccifera Alaterni facie, foliis alternatim ſitis* ; *Tetrapyrene*. Pluk. Mantiſſ. The *Caſſena*. This is the Plant of which the *Indians* make a beloved Decoction, which they drink in great Quantities, even till it becomes Emetick. They have an annual Cuſtom of drinking it in the Spring with great Ceremony, from the King down to the loweſt Subject, and even Children ; at which time they burn all the old Furniture of their Houſes. They ſay it reſtores loſt Appetite, ſtrengthens the Stomach, and gives them Agility and Courage in War, &c.

In *North-Carolina* and *Virginia* it is called *Yapon*, and is uſed by the *Engliſh*; and our Author thinks it the ſame Plant as the *Paraguay* Tea, which comes from *Buenos Ayres*.

58. *Anguis è cæruleo & albo varius*: The *Wampam* Snake; ſo called from the Reſemblance it hath in its Colours to the *Wampam*, or *Indian* Money, made of Pieces of Shells blue and white, ſtrung together.

Lilium Carolinianum; *flore croceo, punctato, Petalis longioribus, & anguſtioribus*: The red Lilly.

59. *Cæcilia maculata*: The Glaſs-Snake.

Chryſanthemum Americanum, Doronici folio, flore floris Mali Perſicæ colore; *umbone magno prominente ex atro purpureo, viridi & Auro fulgente*: This Plant hath flower'd in *England*.

60. *Anguis niger, maculis rubris & luteis eleganter varius*: The Bead-Snake. They are commonly found under Ground.

Convolvulus; *radice tuberoſa, eſculenta*. Sloane's Hiſt. *Jamaic.* Vol. I. p. 150. The *Virginian Potato*. The Roots of theſe Plants are the principal Subſiſtance of the greater Part of *Africa*, and the ſouthern Parts of *Aſia*, as well as moſt of the People, both black and white, in the Colonies in *America*. The Author enumerates five Kinds: the common *Potato*, the *Bermudas*, the *Brimſtone*, the *Carrot*, and *Claret Potatoes*, each of which he gives Deſcriptions of.

FINIS.

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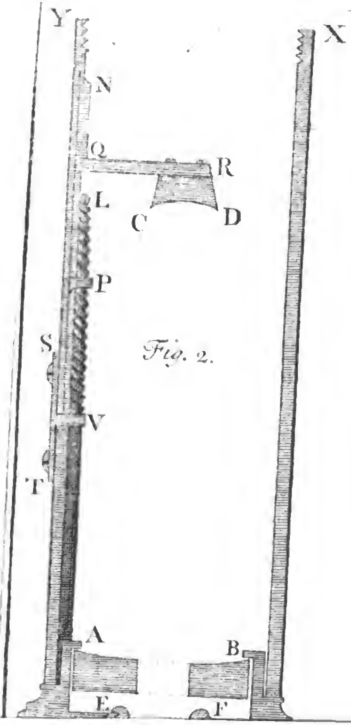

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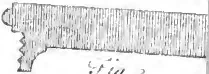

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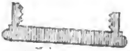

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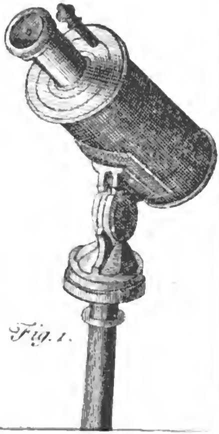

Fig. 1.

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PHILOSOPHICAL TRANSACTIONS.

For the Months of *July*, *Auguſt*, and *Septemb*. 1736.

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I. *A* Catoptric Microſcope. *By* Robert Barker, *M. D. F. R. S.*

THOUGH *Microſcopes*, compos'd of Refracting Glaſſes only, have been vaſtly improved, as to their Effects of magnifying; yet they have been attended with ſuch great Inconveniences, that their Application to many Arts, in which they might be very convenient, is not ſo common as might be expected, and Mankind have reap'd but a ſmall Part of the Advantage obtainable from ſo ſurprizing and uſeful an Inſtrument.

Among the Inconveniences mentioned, theſe are the moſt conſiderable:

1. That in order to magnify greatly, it's neceſſary the Object-Glaſs be a Portion of a very minute Sphere, whoſe *Focus* being very ſhort, the Object muſt be brought exceeding near; it will therefore be ſhaded by the *Microſcope*, and not viſible by any other Light than what paſſes through itſelf; in this Caſe therefore, Opake Objects will not be ſeen at all.

2. Objects illuminated this way, may be rather ſaid to eclipſe the Light, than to be truly ſeen, little more being exactly repreſented to the Eye, than the Out-line; the Depreſſions and Elevations within the Out-line appearing like ſo many Lights and Shades, according to their different Degree of Thickneſs or Tranſparency; though the

contrary happens in ordinary Viſion, in which the Lights and Shades are produced by the different Expoſure of the Surface of the Body to the incident Light.

3. Small Parts of large Objects cannot eaſily be applied to the *Microſcope*, without being divided from their Wholes, which in the Caſe of Vivi ſection defeats the Experiment, the Part dying, and no more Motion being obſerved therein.

4. The *Focus* in the *Dioptric Microſcope* being ſo very ſhort, is exceeding nice, the leaſt Deviation from it rendring Viſion turbid; therefore a very ſmall Part of an Irregular Object can be ſeen diſtinctly this way.

To remedy theſe Defects I have contrived a Microſcope on the Model of the *Newtonian* Teleſcope, in which I have been greatly aſſiſted by that excellent Workman, Mr. *Scarlet*, *jun.* I ſhall ſay nothing of the Effects of this Inſtrument, excepting that it magnifies from the Diſtance of 9 to 24 Inches, having the Honour of ſhewing this Inſtrument to this learned Society.

Explanation of the Figures.

Fig. 1. The entire Microſcope mounted on its Pedeſtal, on a proper Joint, contrived ſo as to direct the Inſtrument, towards any Object.

Fig. 2. The Section of the Inſtrument, in which AB is the larger concave metalline *Speculum*, CD the leſſer Concave metalline *Speculum*; EF a hollow Braſs Screw to faſten in the 1ſt Dioptrical Glaſs, or

Plano-convex Lens; G H another Screw faſtening on the hollow Cylinder EF I K (in which the Dioptric Glaſſes are contain'd) to the Body of the Microſcope; I K a Cap with a ſmall Perforation, ſerving as an Aperture to the Eye-Glaſs, or 2d Lens (convex on both Sides); M L is a long Screw paſſing through the Nuts P and V, ſerving to bring the ſmall *Speculum* to a proper Diſtance from the larger; N Q a ſliding Piece mov'd by the Screw, carrying the Stem Q R, and little *Speculum* C D; YX a Screw for the Cap at *Fig*. 3; that at *Fig*. 4, is to be ſcrewed on the Aperture I K.

Fig. 5. Shews the Conſtruction of the Microſcope, in which *i* is an Object ſuppoſed erect; from which Rays falling on the *Speculum a b*, will be reflected to the *Focus k*, where they will form an inverted Image, and being reflected by the ſmall *Speculum c d*, they will paſs through the Perforation of the great *Speculum*, and falling on the Plano-convex Glaſs *e f*, converge again, and form an erect Image at *l*; which being brought very near to the Eye, and ſo conſiderably magnified, will be diſtinctly ſeen through the Eye-Glaſs *g h*.

II. *An Account of the Standard Meaſures preſerved in the* Capitol *at* Rome. *By* Martin Folkes, *Eſq; V. P. R. S.*

IN the Wall of the Capitol is a fair Stone of white Marble, of the Length of 8 Foot 5 Inches *Engliſh*, and of the Breadth of 1 Foot 9 Inches and a half; upon which are inſcrib'd the Standards of ſeveral Meaſures with theſe reſpective Inſcriptions:

Piede Ro: Pal. IIII. Onc. XII. Deti XVI.
Piede Greco.
Canna di Architet. Palmi X.
Staiolo Pal. V. Quar. III.
Canna di Merca. Palmi otto d' altra miſura.
Braccio di Merc. Pal. III. d' altra miſura
Braccio di Teſſito di Tela.

Curante Lu. Pœto.

The Lines that repreſent theſe Meaſures, are cut in the Marble, pretty deep; but as they have, conſequently, a conſiderable Thickneſs, it is ſomewhat difficult to be very exact in taking off their Dimenſions. I, however, attempted to do it as nearly as I could, by ſetting the Point of my

Compaſſes in the middle of the croſs Lines, that are drawn to determine the Beginnings and Ends of the Meaſures. The Palm of the Architects is eaſier to give than the others, by reaſon the whole Canna is inſcribed on the Stone: This I therefore took off, as I preſume others have generally done, and then divided it into 10 equal Parts. Afterwards my chief Attention was given to the *Roman* Foot, as of greater Conſequence than the other Meaſures. They all, however, follow as they occurr'd to me, in ſuch Parts as the *London* Foot contains a thouſand of.

The *Roman* Foot 966 +. This is divided upon the Stone, firſt into 4 Palms, and then on the upper Part into 12 Unciæ, and on the lower into 16 Deti, according to the Inſcription.

The *Greek* Foot 1006 +. This is alſo divided like the *Roman*.

The *Canna* of the Architects 7325. It is divided into 10 Palms, each of which is therefore 732$\frac{1}{2}$ of the *Engliſh* Foot.

The *Staiolo* being 5 Palms and $\frac{3}{4}$ is 4212—.

The *Canna de Mercanti* divided into 8 Palms of another Meaſure, 6 Foot 6 Inches $\frac{21}{48}$

The *Braccio de Mercanti*, divided into 4 Palms of another Meaſure, 2 Foot 9 Inches $\frac{11}{24}$.

The *Braccio di Teſſitor di Tela*, divided into 3 Parts; 2 Foot 1 Inch $\frac{1}{24}$.

The Palm of the Architects is aſſign'd by Mr. *Greaves* 732 of the *Engliſh* Foot; and the ſame is given by Monſieur *Picart* to the *Paris* Foot, as

494

494¼ to 720; which reduced, becomes 732 + of the *Engliſh* Foot, as before, and as it came out from my own Tryal.

The *Roman* Foot is given by *Picart* from this very Stone 653⅒ of ſuch Parts as the *Paris* Foot contains 720; that is, by Reduction, 967 + of the *Engliſh*; and the ſame by *Fabretti*, who alſo meaſured it upon this Stone, is aſſign'd to the Palm of the Architects, as 2040 to 1545; which reduc'd upon the former Meaſure of the Palm, is 966½ of the *Engliſh* Foot. Theſe Meaſures come out as near as the Nature of the Standard can poſſibly allow; and as it was ſomewhat freſher in Monſieur *Picart*'s Time than it is now, I would make no Difference in the Proportion he has aſſign'd; but ſuppoſe the *Roman* Foot on this Marble was intended to be ſuch a one as ſhould contain 967 Parts of the *Engliſh* very nearly.

Mr. *Greaves* had long before aſſign'd the Meaſure of the *Roman* Foot from *Coſſutius*'s Monument, to be 967 of the *Engliſh*, and had preferred that Meaſure to the others he had taken from the Tomb of *Statilius*, and the *Congius* of *Veſpaſian*. And I think one can make no doubt, from what has been ſaid, but *Coſſutius*'s Foot was the Foot intended to be inſcribed upon this Marble; though that Monument is itſelf now loſt: at leaſt when I was at *Rome* I could get no Intelligence of it, though I made a diligent Enquiry amongſt all the People likely to be acquainted with it.

Fabretti, in his Work concerning Aqueducts, where he gives the above-mentioned Proportion of the Palm to the Foot, finds fault with *Lucas Pætus*, as having made a wrong Calculation of this Proportion in his Book, *De Menſuris & Ponderibus*. True it is, that the Proportion there given by *Pætus*, does not agree with the Foot upon the Marble, but yet it is no falſe Calculation, as *Fabretti* thought; and had he examined *Pætus*'s Book with Care, he would have been ſenſible this is not the Foot he there contends for, but the *Coſſutian* Foot which *Lucas Pætus* in his Book diſputes againſt. The Truth therefore is, that he either alter'd his Mind after the writing of that Book, before the Marble was ſet up; or, more probably, that tho' he had the Care of having theſe Meaſures inſcribed on the Marble, he was directed by a ſuperior Authority what Meaſures he was to have engraved; and that accordingly he had, as near as he was able, the *Coſſutian* Foot deſcribed for the ancient *Roman* Foot on the Stone: And that this was the Caſe, and no Miſtake about the Number, as *Fabretti* ſuppoſes, appears not only from the Tenure of his Book, where he condemns *Coſſutius*'s Foot, which there appears, but alſo from his Scheme at the latter End, where he has given what he calls *Scema pedis legitimi*, agreeing with his own Numbers, *viz.* 12 Inches, whereof $9\frac{4}{9}$ make the Palm of the Architects, and alſo the *Menſura Colotiani & Statiliani pedis*, agreeing with that now inſcribed on the Marble. The *Colotian* is the ſame Monument as the *Coſſutian*, ſo called from the Perſon in whoſe Poſſeſſion it had formerly been; and he had before ſaid, p. 5. that according to the Teſtimony of *Philander*, the *Statilian*

tilian agreed with it; though Mr. *Greaves*, who meaſured both theſe Feet with great Care, found ſome Difference between them, ſtating the *Coſſutian*, as above, 967, and the *Statilian* 972. But by *Pætus*'s quoting *Philander*, it is plain he had not himſelf meaſured the latter; and therefore the Foot, called by him the *Colotian* and *Statilian*, is indeed purely the *Colotian* or *Coſſutian* Foot; and the ſame has occurred to me alſo very nearly from my Meaſure of the Height of the *Trajan* Pillar, which I find, from the Ground to the Top of the Cimatium of the Capitol, to be 115 Feet 10 Inches $\frac{5}{8}$; and this Height divided by 120, gives very nearly 966 for the Quotient.

For the *Greek* Foot there ſeems to be no further Myſtery, than that it was intended to be made to the *Roman* in the Proportion collected from *Pliny*, which is, that 625 *Roman* Feet made 600 *Greek*; by which Account the *Greek* Foot ſhould contain 1007 of ſuch Parts as the *Roman* contains 967; and the actual Quantity I took off was 1006.

III. Obſervationes nonnullæ notatu non indignæ, Anno 1734. *Ab* Johanne Frid. Weidler, *R. S. S.* &c. Vitembergæ factæ.

1. DIE xxiii. *Januar.* A. 1734. iterum apparuit ſplendida admodum *Aurora Borealis*, veſperi hor. vii. m. 6. Sub ſeptentrionem viſus arcus ater,

cum duplici faſcia candida eidem inſidente, quam nigra regio media diſtinguebat; aſſurgebat arcus ultimus candidus ad altitudinem 25 graduum; in tractu nigro ſubinde incendebantur pyramides lucidæ; reflexo lumine prope Zenith ſimilis candidus arcus producebatur; h. vii. 30′. albus tractus in occaſum longius ultra ipſum occaſus æquinoctialis cardinem diffundebatur, attingebat in medio altitudinem 50 graduum; h. vii. 35′. clara regio uſque in verticem diducebatur; nubes hinc inde intermiſſæ verſus occaſum tendebant, id quod raro in Auroris Borealibus ſolet evenire; admiratus etiam ſum nubes quaſdam circa N. E. hærentes, quæ ante regionem lucidam promovebantur, et ultra quas lux auroræ diſtincte cernebatur; ex quo elucet auroræ lumen longe ultra nubes attolli. h. vii. 38′ lucida auroræ regio infra horizontem ſeſe demittebat, imprimis verſus occaſum; etiam illud meretur attentionem, quod etſi hæc aurora ſplendida eſſet admodum, paucas tamen pyramides lucidas oſtentaverit: hor. viii. 30′ fere tota lux infra horizontem fuit condita, eminebat adhuc prope occaſum altitudine 10 graduum; tractus arcus nigri ſub ſeptentrione una cum exigua faſcia candida imminente adhuc hora x. conſpiciebatur.

2. Die xxvii. *Januar.* veſperi hor. vi. 23′. notata fuit ☌ ☽ ♀. nempe reperi ♀ L 35. minutorum unius ♀ • L ◡ gradus: *Venus* meridiem, luna ſeptentrionem reſpiciebat, hor. vi. 57′ ♀ L = 26′ & in hac obſervatione linea per Venerem & utramque falcis lunæ cuſpidem ducta recta erat, poſtea luna ſenſim longius à Venere exceſſit.

3. Die xvii. *Februarii* non prætereunda eſt humilitas mercurii in barometro ad 28 Dig. 7. Lin. qualem antehac heic locorum non animadverti ; præſagium inde capere licuit horrendæ procellæ, & impetus ventorum, qui omnia ſuſque deque verſurus videbatur, lateres e tectis p. m. hor. iii. magno numero dejiciebantur, ut nemo in plateis tutus poſſet ambulare. hæc procella in *Saxonia* et alibi in *Germania* paſſim ædificiis, ſylvis, hortiſque damna longe maxima intulit, incredibilem arborum numerum radicitus evulſit, fregit annoſas quercus aliaſque arbores, homines in libero campo pedibus conſiſtere nequiverunt.

4. Die xix. *Martii* veſperi hor. vi.45′ circa N.N.W. ſub ſeptemtrione apparuit arcus ater faſcia alba lata extenſa veſtitus ; lux albæ faſciæ clarior erat verſus occaſum, quam verſus ortum, ſed pyramides lucidæ vel undæ, quales auroras boreales comitari ſolent, inſecutæ non ſunt. Sunt ergo quædam auroræ boreales quæ candidam tantum ſub ſeptentrione cœli regionem, ſed ſine lucis motu oſtendunt.

5. Die xxix. Martii aurora borealis inſignis explenduit, quam primum conſpexi hora ix. Luna vergebat in occaſum, & per nubes, tantum lucebat ; cœlum totum fere nubibus tectum erat & tamen circa ſeptentrionis cardinem clara poſt diſtractas nubes regio, e qua lucidæ ſubinde pyramides, certiſſimo auroræ borealis præſentis indicio, prodibant : deprehendi etiam poſt nubes lucidum auroræ tractum in arcum componi : lucidæ pyramides uſque ad hor. xi. obſervari potuerunt ; rarum ſpectaculum

cœlo nubiloſo & aere ventis agitato, auroram borealem ſpectari, quæ alias fere tantum ſereno et tranquillo cœlo omicare ſolet.

6. Die ix Auguſti cum in vallum obſervandi Saturni cauſa me contuliſſem hor. xi. ſubito nubes quædam tenues circa N. N. E. & N. g. E. ſuſpenſæ ardere viſæ ſunt. Verum paucis radiationibus emiſſis verſus verticem ceſſebat inflammatio, & nubeculæ in ortum leni vento propellebantur.

Ex his aliiſque obſervationibus, quam varium et mutabile ſit auroræ borealis lumen phænomenon, luculenter intelligitur.

IV. *Obſervations made of the* Latitude, Variation *of the* Magnetic Needle, *and* Weather, *by Capt.* Chriſtopher Middleton, *in a Voyage from* London *to* Hudſon's-Bay, Anno 1735.

Month.	Day.	Hour.	Altitude of the Thermometer.	Altitude of the Barometer.	Latitude by Account	Longitude from *London* by Account	Variat. of the Compaſs.	Latitude obſerv'd by *Smith's* Quadr.	Latitude obſerv'd by *Hadley's* Quadrant.	Latitude obſerv'd by *Elton's* Quadra.	Latitude by a Sextant of *Ward* & *Smith*.	Winds.	Remarks.
			° '	° '	°	° '	W.	° '	° '				
		6	27	29. 9								S W to S E	Variable, with ſome Rain.
May	31	12	24	29. 6	60. 0	19.11	23						
		9	29. 7	29. 7									
		6	29. 7	29. 7								S E to S W	Variable the firſt two Parts, moderate the latter, freſh Gales and a great Sea.
June	1	12	25	29. 5	59.50	23.33	24						
		9	25	29. 5									
		6	26	29. 4								S W to S by E	Cloudy, and ſqually with Rain.
	2	12	26	29. 3	59.55	25.53	25	59.54	59.59				
		9	27	29. 8									
		6	28	29. 9								S W	Frequent Showers of Rain; with Squalls.
	3	12	26	28. 8	60	28. 3	26	59.57	60				
		9	27. 9	30. 1									
		6	29	30. 5								S W	Uncertain ſqually Weather, with a Weſtern Swell.
	4	12	26	29. 8	60.40	29.25	26	60.39	60.41				
		9	27. 9	30. 1									
		6	28	30								S W	Squally, with ſome Rain.
	5	12	26	29. 8	60.31	32.12	27						
		9	25	29. 7									
		6	28	29. 7								S W. to N N W	Variable, with Squalls of Rain.
	6	12	25	29. 5	58.44	35.46	27	58.47	58.50				
		9	24	29. 5									
		6	28	29. 5								N N W to W N W	Variable freſh Gales, with Rain and Squalls.
	7	12	28	29. 9	58.11	36.58	28	58. 8	58.11				
		9	30	29. 8									
		6	30	29. 9								N N W to W by S	Moderate and fair Weather, with Clouds.
	8	12	28	29. 8	57.50	38.33	28	57.53	57.57				
		9	26	29. 6									

June

June 9	6	26	29. 9	58.28	42.16	28	58.28	58.38			W b S to S b E	Rain and freſh Gales.
	12	25	28. 9									
	9	26	29. 6									
10	6	31	29. 8	58.25	43.11	29	58.16	58.22			N W	Hard Gales, with a great Sea.
	12	28	30									
	9	26	30. 4									
11	6	30	29. 8	58.48	44.16	29	58.40	58.45			N W to N E	Moderate, with ſome Rain.
	12	27	29. 8									
	9	28	29. 9									
12	6	30	30	58.22	45.46	29					N N E to W b S	At 6 made Cape *Farewell*, from NbW to NbE 14 or 15 Leagues diſt. Moderate with ſome Rain.
	12	28	29. 6									
	9	28	29. 8									
13	6	27	29	58.12	45.37	29	58.10	58.13			N W	Much Ice in Sight. An hard Gale, with a great Sea.
	12	27	29. 7									
	9	32	29. 9									
14	6	31	30. 1	58.12	46.11	30	58.10	58.11			N N W to E S E	Moſt part hard Gales. Under Main Sail and Mizen.
	12	26	29. 9									
	9	29	30.23									
15	6	29	30. 5	59. 7	49.49	31					E S E to S E	Saw a large Iſle of Ice. Pleaſant Weather.
	12	29	30. 1									
	9	27	30									
16	6	26	30. 1	60.14	55. 3	33					S E b S	Freſh Gales and cloudy, with ſome Rain.
	12	27	30. 1									
	9	27	29. 9									
17	6	30	31	61. 7	59.43	36					S b E to S E b S	Moderate, but hazy, with Rain.
	12	26	29. 9									
	9	26	29. 9									
18	6	31	29. 9	61.23	63. 7	39					S E	Hazy, with Rain and Fogs. Several Pieces of Ice.
	12	28	29. 5									
	9	27	29. 7									
19	6	27	29.85	61.47	63.16	39	61.44	61.49	61.54		S E S S W S b E	Foggy, with Calms. Much Ice all round *Reſolution*.
	12	31	30									
	9	30	29. 9									

Month.	Day.	Hour.	Altitude of the Thermometer.	Altitude of the Barometer.	Latitude by Account	Longitude from London by Account	Variat. of the Compafs.	Latitude obferv'd by Smith's Quadra.	Latitude obferv'd by Hadley's Quadrant.	Latitude obferv'd by Elton's Quadrant.	Latitude by a Sextant of Ward & Smith.	Winds.	Remarks.
			° ′	° ′	° ′	° ′		° ′	° ′	° ′	° ′		
		6	28	30. 1								W N W	
June	20	12	29	30	61.40	64. 8	39			61.46		Wt	Moderate Weather, moſt part Foggy.
		9	30	29. 8								S W b S	
		6	29	29. 8								Wᵗ	
	21	12	29	30. 6	61	64.34	39	61. 4	61. 5	61.12		W N W	Much Ice all round; fore Part Foggy, latter clear.
		9	29	30. 8								N b W	
		6	32	29									
	22	12	27	29. 4	61.11	65.40	40		61	61.12	61.12	N b W	The moſt part foggy and hazy Weather.
		9	28	29. 9									
		6	30	29. 9								S°	
	23	12	27	29. 8	61.30	66.50	40			61.30	61.30	S W	Fair, with much ſhatter'd Ice, and large Iſles.
		9											
		6											
	24	12	24	29. 8	61.37	67.19	41	61.36		61.38		W N W	Eaſy Breezes, fair and clear, heavy Ice all round.
		9	26	29. 6									
		6	28. 5	29. 9									
	25	12	27	29. 6	61.53	68.12	42					Ditto	Hazy middle Part, clear the latter.
		9	28	29. 8									
		6	28	29. 7									
	26	12	27	29. 8	61.41	68.42	41					S W b W	Fair pleaſant Weather; much Ice.
		9	30	39. 9									
		6										N N E	
	27	12	29	29. 7	61.30	68.42	41					W S W	Little Winds, and fair pleaſant Weather.
		9	29	29. 6									
		6	31	29. 8									
	28	12	29	29. 6	61.33	69. 2	40						Moſt Part foggy, with Calms.
		9	29	29.75									
		6	23	29. 5									
June	29	12	27	29. 6	61.30	69.13	40	61.30		61.30	61.20	E S E	Several large Iſles of Ice; foggy.
		9	25	29.75									

June

June 30	6	26	29. 9	61.33	69.26	40					ESE to WSW	Little Winds and calm; heavy Ice all round.
	12	26. 5	29. 5									
	9	27	19. 9									
July 1	6	29	29. 9	61.28	70.10	41					E S E	Faſt in thick Ice, with Fogs and Rain.
	12	27. 5	29. 7									
	9	27. 5	29. 6									
2	6	32	29. 1	61.28	70.37	41					S E to N E	Theſe 24 Hours the firſt and latter Parts freſh Gales, middle a Storm of Wind and Rain.
	12	31	29									
	9	26. 5	29. 3									
3	6	29. 5	29. 5	61.28	70.22	41					N W	Hard Gales, with much Snow.
	12	28	29. 8									
	9	27. 5	29. 9									
4	6	32	29. 9	61.28	70.26	40					N W	Moderate and fair Weather, with much Ice.
	12	29. 5	29. 6									
	9	25. 5	29. 3								N b W	
5	6	29	29. 8	61.39	70.36	40	61.33		61.44	61.43	W b S	Working to Windward in Ice, ſometimes in a Clear.
	12	27	29. 9									
	9	29	29. 7									
6	6	31	29. 9	61.46	70.54	40		61.54		61.53	W S W to N E b N	Moſt Part fair and pleaſant Weather, with much Ice.
	12	27. 5	29. 7									
	9	26	29. 7									
7	6	27	29. 4	61.55	71.13	40					N E to N W b N	Foggy Weather, cloſe Ice all round.
	12	27	29. 6									
	9	27	29. 9									
8	6	29	29. 7	61.46	70.21	40					Ditto.	Moderate, with Fogs.
	12	26	29.75									
	9	25. 5	29. 9									
9	6	29	29. 9	61.42	71.40	41			61.38		Ditto.	The firſt Part hazy, the latter clear.
	12	27	30									
	9	27	30									
10	6	32. 5	29. 7	62.18	75.13	41					N W to S E	Clear Sea, freſh Gales and hazy.
	12	29. 5	29. 6									
	9	26	29.75									

Month.	Day.	Hour.	Altitude of the Thermometer.	Altitude of the Barometer.	Latitude by Account	Longitude from *London* by Account	Variat. of the Compaſs.	Latitude obſerv'd by *Smith's* Quadra.	Latitude obſerv'd by *Hadley's* Quadrant.	Latitude obſerv'd by *Elton's* Quadrant.	Latitude by a Sextant of *Ward* & *Smith.*	Winds.	Remarks.
			° ′	° ′	° ′	° ′		° ′	° ′	° ′	° ′		
July.	11	6	31	29. 7	62.31	76	42					S b W	Foggy Weather.
		12	27	29. 9									
		9	28	29.75									
	12	6	31. 5	29. 9	63. 5	75.28						Ditto.	Ditto.
		12	31. 5	29. 9									
		9	28	30									
	13	6	30	30. 2	63.15	75				63.20		S to N W	Working in looſe Ice; hazy, ſometimes clear.
		12	29	30. 3									
		9	27. 5	29. 9									
	14	6	31	30	63.25	74.38						N W to Weſt	Much Ice, fair and clear, with Calms.
		12	27	30									
		9	25	30									
	15	6	30	29. 9	63.20	76						S S E to E S E	Much Ice, freſh Gales and hazy.
		12	27	29. 8									
		9	27	29. 8									
	16	6	27	29. 8	63.10	77.20						S E	Looſe Ice, large Clears in Sight of *Saliſbury*.
		12	26	29. 7									
		9	26. 5	29. 7									
	17	6	27. 5	29. 7	63.10	78.20	44					E S E	Foggy, much Ice and freſh Gales.
		12	27. 5	29. 6									
		9	26	29. 7									
	18	6	29	29. 6	63	78	43					Calm.	Looſe Ice Eaſt End of *Nottingham*, N b E ſeven Leagues.
		12	26	29. 8									
		9	26	29. 8									
	19	6	25	29. 9	63.10	78.20	43					E S E	Much Ice, clear Weather. Cape *Walſingham* S W b W five or ſix Leagues.
		12	24	29.85									
		9	27	29.80									
	20	6	28	29.85	63.20	78.30	41					S W	Shatter'd Ice, foggy Weſt; Iſland *Diggs*, W S W five Leagues.
		12	27. 5	29.84									
		9	27	29. 9									

July

July 21	6	27. 5	29.98	63.10	79.50	42					S S E	Cape *Diggs* S E b S 6 Leagues. Freſh Gales, and Ice.
	12	25. 5	29. 9									
	9	24	29. 8								S b W	
22	6	27	29. 9	63	80.13	42					SW bW to South.	Much large Ice; the North End of *Mansfield* S W b W four Miles.
	12	25	29. 9									
	9	23. 5	30. 1									
23	6	26. 5	30. 1	63. 4	81.10	44			62.52		S W	North End of *Mansfield* S W fourteen Miles.
	12	26	30.									
	9	25	30									
24	6	29. 5	29. 9	61.34	82.52	40			61.26		E b S to S S E	Hazy; ſome Pieces of Ice.
	12	29. 5	29. 9									
	9	26	29.85									
25	6	31	29.82	61.15	83.56	38			61.14	61.17	S S W	Much Ice, and Rain.
	12	28	29.82									
	9	26	29.83								S b E	
26	6	32	29. 7	60.45	84.23				60.41		S b E to W b N	Thick foggy Weather, with Showers of Rain.
	12	29	29. 7									
	9	29. 5	29. 9									
27	6	30. 5	29. 9	59.39	84.11	30	59.36		59.34		N W to Weſt.	Steering Ice, with wet Fog.
	12	26	29. 9									
	9	26	30. 1									
28	6	28	30. 1	58. 9	82.44	28	58. 5	58. 2			N b W	*Baker's Dozens* S b W four Leagues. Fair Weather.
	12	26	30. 1									
	9	26	30. 1									
29	6	28	30	56.46	82.45	26			56.30		W b S	Moderate, with Fogs, Rain and Ice.
	12	26	30									
	9	25	29.95									
30	6	27. 5	29.85	55.51	82.39	25					N WbW	Freſh Gales. A great Sea from the Southward.
	12	25. 5	29. 9									
	9	23	30									
31	6	26	29. 9	54.44	82.47	24					N E	Thunder and Rain. *North-Bear* S W by W five Miles.
	12	25. 5	29. 5									
	9	24	30									

Month.	Day.	Hour.	Altitude of the Thermometer.	Altitude of the Barometer.	Latitude by Account	Longitude from *London* by Account	Variat. of the Compaſs.	Latitude obſerv'd by *Smith's* Quadra.	Latitude obſerv'd by *Hadley's* Quadrant.	Latitude obſerv'd by *Elton's* Quadrant.	Latitude by a Sextant of *Ward* & *Smith*.	Winds.	Remarks.
			° ′	° ′	° ′	° ′		° ′	° ′	° ′	° ′		
		6	26	30									
Auguſt	1	12	25. 5	29.98	53. 3	81.20	22					N E	Moderate and fair Weather.
		9	23	29.85									
		6	24	29. 8								South to North.	The firſt Part moderate, the latter hard Gales, with Thunder and Lightning in with the W. Main.
	2	12	23. 5	29. 9	52.20	82							
		9	24	29. 9									
		6											
	3	12	26	30	51.40	83							Arrived in *Mooſe-River* Road.
		9											
		6											
	4	12											
		9											
Sept.	1	12	27	29.85	55.36	Weſt. 00.42	22					Weſt and W b N	Moderate and fair.
		9	29	29.85		from *Bear.*						N W to North.	Moderate Gales and Hazy, with ſmall Rain.
	2	12	27	30. 5	53.50	1.16	26						
		9	26	30. 8									
		9	30	29. 8								N b W to N b E	
	3	12	26	30. 4	56. 6	1.16	26						Ditto.
		9	23	31. 5									
		9	30	29. 8								South to Eaſt.	The firſt Part moderate, middle and latter very hard Gales, with Squalls of Rain.
	4	12	26	30. 6	58. 6	2.58	30						
		9	23	31									
		9	33	29. 8									
	5	12	33	29.85	58.28	4.26	30					N E b E	Ditto, hard Gales and Squalls.
		9	34	30									
		9	33	30. 1								E N E North.	Freſh Gales and ſqually, with a Head-Sea.
	6	12	32. 5	30. 2	58.40	3.23	31	58.42	58.49				
		9	32	30. 2									

Sept.

	9	27	29. 9								N W	Ditto, Gales and Snow.
Sept. 7	12	27	29. 8	60.45	1.15	31						
	9	26	30. 1									
	9	37. 5	30. 3		Eaſt.						S W	Strong Gales and ſqually; great Sea from the North-Weſt.
8	12	35	30. 2	61.37	0. 4	32					to	
	9	32	30. 1								N W	
	9	34	30. 3		Eaſt.						N W	Moderate and fair; four Leagues from the SouthEnd of *Manſfields* 76 Fathom, Mud.
9	12	32. 5	30. 3	61.55	0. 4	33					to	
	9	32	30. 5								N N E	
	9	32	30. 5		Weſt.						N b E	Little Winds and fair Weather. In Sight of *Manſfields.*
10	12	29	30. 5	61.58	1. 0	34	61.43	61.45	61.46			
	9	30	30. 5								S W	
	9	36	30.25		Eaſt.							Fair and pleaſant Weather. In Sight of *Manſfields,* 4 Miles.
11	12	30	30. 1	62.30	2.21	43	61.30				S W	
	9	28	30									
	9	30	30. 1		Eaſt.						W S W	At Noon *Manſfields* NWbW 5 Leagues; Sleet and foggy. Cape *Walſingham* SW 6 Leagues.
12	12	30	30	62.52	2.28	42					to	
	9	30	30. 1								WNW	
	9	32	30. 3		fro.Digs						N W	Frequent Showers of Hail and Snow.
13	12	33	30.25	63. 9	3.40	43					to	
	9	32	30. 2		Eaſt.						N b E	
	9	31. 5	30. 1		Eaſt.						N N E	Moderate and fair Weather.
14	12	29	30. 5	62.50	6.44	42						
	9	31	30								Calm.	
	9	30. 5	29. 5								S W	Much Snow, with thick Weather.
15	12	30	29.46	62.22	7.55	42	62.21	62.23			to	
	9	29	29. 5								WNW	
	9	29	29. 8								N W	Paſs'd ſeveral large Iſles of Ice; freſh Gales and Sleet; thick Weather with Snow.
16	12	30	30	61.43	12	42					to	
	9	28	30. 3								N b E	
	9	32. 5	30. 4								North	Firſt 2 Parts hard Gales and Snow, latter moderate. At Noon Cape *Reſolut.* NE6L. S. Pt. NWbN4L.
17	12	33	30. 5	61.43	15.10	40					to	
	9	31	30.55								N N E	

Sept.

Month.	Day.	Hour.	Altitude of the Thermometer.	Altitude of the Barometer.	Latitude by Account	Longitude from London by Account	Variat. of the Compass.	Latitude observ'd by *Smith's* Quadra.	Latitude observ'd by *Hadley's* Quadrant.	Latitude observ'd by *Elton's* Quadrant.	Latitude by a Sextant of *Ward & Smith.*	Winds.	Remarks.
			° '	° '	° '	West. ° '		° '	° '	° '	° '		
Sept.	18	9	31	30. 4	60.40	58.40	40					N E b N	Many large Iſles of Ice; hard Gales; great Sea from the North-Eaſt.
		12	34	30. 3									
		9	31	30. 4									
	19	9	33	29. 9	59.49	53.43	38					North to S W	Moderate, but dark and cloudy, with Sleet and Rain.
		12	26	29. 5									
		9	26	29. 5									
	20	9	30	29. 7	58.42	48.52	32	58.37	58.38			N W	Freſh Gales, with Rain and Snow.
		12	29	29.65									
		9	29	29. 6									
	21	9	31	29. 5	57.28	44.31	29					N N W to North.	Variable, with freſh Gales and Rain.
		12	30	29. 6									
		9	29	27. 7									
	22	9	27. 5	29. 5	56.49	41.39	27					North to E S E	Freſh Gales and Squalls; variable Winds and cloudy.
		12	27. 5	29. 5									
		9	27	29. 6									
	23	9	29	29.65	55.52	36.50	25	55.44	55.47			N E b E to N b W	Hard Gales, with Rain and Fogs.
		12	26. 5	29. 5									
		9	26	29. 7									
	24	9	31	29. 8	55. 3	31.21	24	55. 1	55. 4			N N W	Freſh Gales, and Rain.
		12	27	39. 9									
		9	26	29. 8									
	25	9	27. 5	30	53.43	25.59	23					N W b N to S W b W	Hard Gales, with Squalls and ſmall Rain.
		12	26	30									
		9	26	30. 2									
	26	9	21	30. 2	52.38	22.23	22					S W to S W b S	Firſt Part hard Gales, middle and latter moderate and hazy.
		12	19	30. 2									
		9	20	30. 1									
	27	9	21	30	52.27	20.15	21					South to N N E	Freſh Gales, and much Rain; hazy Weather.
		12	20. 5	31									
		9	24	30. 1									

Sept. 28	9	25	30. 2	50.30	16.33	20	51	51			N E	Freſh Gales, and much Rain; hazy Weather.
	12	25	30.25									
	9	24	30. 2									
29	9	23	30. 3	50.20	13. 7	19	50.24	50.25			N E to N b W	Freſh Gales and hazy, with ſome Rain the firſt two Parts, the latter moderate.
	12	23	30. 2									
	9	24	30. 2									
30	9	23	30. 2	50.37	11.41	18	50.30	50.35			N W to S by E	Moderate and fair; Winds variable.
	12	21. 5	30. 3									
	9	20	30. 2									
Octob. 1	9	22. 5	30. 3	50.35	11.22	18					S S E	Moderate, with a great Head-Sea from the Eaſtward.
	12	22	30. 2									
	9	22	30. 3									
2	9	22	30. 3	49.40	12.32	18					S E b S	Cloudy, with a great Sea from the Eaſtward.
	12	23	30. 2									
	9	22	30									
3	9	22	29	50. 7	11.39	18					S S E to S b E	Hard Storm of Wind, with a great Sea.
	12	22. 5	29									
	9	22. 5	30. 1									
4	9	20	29. 9	50. 3	10.36	17	50. 4				S S W	Moderate Gales, with ſmall Rain.
	12	20	30. 1									
	9	20	30.25									
5	9	20. 5	30.35	49.38	8.52	16	49.42				S S W to Weſt.	Ditto, fair and moderate.
	12	20. 5	30. 3									
	9	20. 5	30. 4									
6	9	22	30. 2	50	7.20	15	50. 5				South Calm S S E	Saw ſeveral Ships, ſounded 100 Fathom. Moderate.
	12	22	30. 1									
	9	22	29. 9									
7	9	22	29. 9	49.39	6.58	15	49.38				S S E W N W	Two firſt Parts hard Gales and heavy Squalls, the latter moderate.
	12	21	30									
	9	21	29. 9									

An

An Explanation of the TABLES.

The firſt Column contains the Month; the ſecond Column is the Day of the Month; the third the Hour of the Day, beginning at Six in the Morning, to Twelve at Noon, and Nine at Night; the fourth Column is that of the Thermoſcope; the fifth Column is the Height of the Mercury in the Baroſcope, the firſt Number is the Inches of its Height, the ſecond and third Number marks the tenths and hundredth Parts of an Inch; the ſixth Column is the Latitude the Ship is in, by Account, every Day at Noon; the ſeventh Column is the Longitude the Ship is in every Day at Noon, by Account, from the Meridian of *London* (except where otherwiſe expreſs'd). The Column Variation, is the Variation of the Needle; and the next four Columns are the Latitudes obſerv'd at Noon by four ſeveral new Inſtruments; the firſt is Mr. *Smith*'s Priſmatic Quadrant, the ſecond is Mr. *Hadley*'s, the third by Mr. *John Elton*, and the fourth by Mr. *Caleb Smith* and Mr. *William Ward*; the next Column is the Wind for the moſt Part of the Twenty-four Hours.

The Thermoſcope which I made uſe of in the Voyage, was made by Mr. *John Patrick*, together with the Baroſcope; in his Thermoſcope he places [°] at the Top, ſuppoſing it to be the Heat under the Line, and ſo the Figures increaſe downwards, with the Increaſe of Cold. Temperate is placed at 25.

This Priſmatic Quadrant of Mr. *Caleb Smith* I find to be of very great Uſe at Sea, in particular for the Stars, as I have experienced ſeveral times in my Voyage to *Hudſon*'s *Bay*, in the worſt of Weather, when you can but ſee the Horizon; and his other is of great Uſe, in tolerable ſmooth Water, in foggy and hazy Weather, when there is no Horizon to be ſeen, yet have the Benefit of the Sun.

IV. *An* Experiment *to ſhew that ſome* Damps *in* Mines *may be occaſioned only by the burning of* Candles *under Ground, without the Addition of any noxious* Vapour, *even when the Bottom of the Pit has a Communication with the outward* Air, *unleſs the Outward* Air *be forcibly driven in at the ſaid Communication or Pipe. By the Reverend* J. T. Deſaguliers, LLD. F. R. S.

EXPERIMENT I.

IN a Cylindric Glaſs-Receiver, open at both Ends, whoſe lower End is plung'd in Water, and upper End cover'd with a Plate with an Hole of near an Inch Bore, a Candle of Six in the Pound will not burn quite the Time of one Minute before it goes out.

EXPERIMENT II.

A Candle will burn almoſt as long when the Receiver is quite cover'd.

EXPERIMENT III.

The Receiver having the Hole of the Plate open, and a Pipe at Bottom communicating with the external Air, will burn but a little longer than in the firſt Experiment; and if you blow in at the Pipe with your Mouth, it will go out rather ſooner.

EXPERIMENT IV.

Blow in at the Pipe with Bellows, and the Candle will burn as long as you will.

V. *A* Chemical Experiment *by Mr.* John Maud, *ſerving to illuſtrate the* Phœnomenon *of the* Inflammable Air *ſhewn to the* Royal Society *by Sir* James Lowther, *Bar.* *as deſcribed in* Philoſoph. Tranſact. *Numb.* 429.

SIR *James Lowther* having formerly favour'd the Society with an Experiment upon ſome Air which he collected out of a Coal-Mine, and brought in Bladders cloſe tied, by Sea to Town: The Effect of which was, that the Air being preſs'd out of the Bladder through the ſmall Orifice of a Tobacco-Pipe, would catch Fire from a lighted Candle, and burn like an inflammable Spirit, until it was all conſumed. A particular Account of which has been printed in the *Philoſoph. Tranſ.* Numb. 429. *p.* 109, *&c.*

Upon conſidering that the Cauſe was only a great Quantity of ſulphureous Vapours fluctuating in that Air, I was naturally induced to make an

Eſſay, by an artificial Mixture, to produce the like Effect. It is very well known to every one verſed in Chemical Affairs, that moſt Metals emit great Quantities of ſulphureous Vapours, during the Efferveſcence which they undergo in their Solutions in their reſpective *Menſtrua*, or *Solvents*. Of theſe Fumes Iron emits a great Quantity whilſt it is diſſolving in Oil of Vitriol, which are very inflammable, and not eaſily to be condens'd. Theſe Fumes I collected into a Bladder with the deſired Succeſs, and having produc'd before the Society two Bladders of this fictitious Air, at the ſame time that Sir *James Lowther* was pleaſed to make trial of his, they both exhibited the ſame Phenomena. I ſhall here give a more particular Account of the Preparation made uſe of, which was as follows.

I took ʒij of Oil of Vitriol and mixt it with ℥viij of common Water, which I put into a Glaſs with a flat Bottom about ten Inches wide and three deep, with a long Neck; to this I added ʒij of Iron Filings: There inſtantly aroſe a great Heat, with a violent Ebullition, and the Iron was wrought upon very faſt, with Fumes copiouſly exhaling. To the End of the Neck of the Glaſs I luted a Bladder void of Air, the Neck of the Bladder being faſten'd to a Tobacco-Pipe; the Fumes ariſing from the diſſolving Metal ſoon puffed up the Bladder to its full Extent, when that being taken away, the Neck of it being firſt tied cloſe with a String, I applied another in the ſame manner: Thus you may get as many Bladders full as you can, whilſt the Efferveſcence laſts. Two of theſe Bladders were tried before the Society, and exhibited a Flame like thoſe of Sir *James Lowther*, very like in the Smell, tho' ſomewhat different in the Colour of the Flame. After I had preſs'd Part of the Air out of the Bladder, by drawing back the Hand, the Flame was ſuck'd into the Bladder, and ſet on Fire, what inflammable Air remain'd, all at once; which went off like a Gun, with a great Exploſion.

What is worthy of Notice in this Experiment is, that all the Air which fill'd the Bladders was as it were generated *de novo* out of the Mixture, or elſe recover'd from being lock'd up in the Body of the Metal in an unelaſtic State.

This Experiment will eaſily explain a very probable Cauſe of Earthquakes, Vulcanos, and all fiery Eruptions out of the Earth; for nothing more is requiſite than an Intervention of Iron with a vitriolic Acid and Water. Now Iron is generally found accompanied with Sulphur: And common Sulphur may be analyſed into an inflammable Oil, and an acid Liquor like Oil of Vitriol. This Acid therefore in the Bowels of the Earth, by being diluted with a little Water, ſurrounds the Iron, and works upon it in the ſame manner as deſcribed above; an Effervefcence and inteſtine Heat ariſes; the Air which comes from the Mixture is rarified, and becomes very elaſtic, its *Impetus*, by how much the more compreſſed by the incumbent Weight of Earth, is increaſed even to an unlimited Degree, and at length, like Gun-powder, will remove all Obſtacles, and will exhibit to the Spectators above Ground the terrible Phenomena of Earthquakes and Eruptions. Theſe inflammable Fumes ſometimes, if very much heated, will, as ſoon as they come to the open Air, catch Fire, and ſo produce thoſe fiery Eruptions, of which there are ſo many Inſtances in the World.

VII. *A Letter from Mr.* Henry Forth *to the late Rev*^{d} William Derham, *D. D. Canon of* Windſor, *and F. R S. concerning the Storm* Jan. 8*th*, 173$\frac{4}{5}$.

Darlington, Jan. 18, 173$\frac{4}{5}$.

Honoured Sir,

ALTHO' I am not ſo happy as to be acquainted with your Perſon, I am no Stranger to your Labours, wherewith you have obliged the World; and that Part which relates to Obſervations upon the Alteration of the Weather, I have for ſome ſmall time purſued, for my own private Satisfaction, upon your ingenious Model.

The diſmal Accounts we have had from the Southern Parts, of the Storm of Wind which happened on the 8th Inſtant, put me upon reflecting, that one of your Curioſity might deſire to know how our Northern Regions were affected by it; which will, I hope, be a ſufficient Apology for this Liberty.

The Place from which I write, and where I reſide, is 14 Miles South of *Durham*, Lat. 54° 46′. The Evening before the 8th, my Barometer ſtood at 29 Inches, but had been gradually falling for two Days. The Wind was then S. W. high in the ſecond Degree; which increaſed towards Midnight a Degree more. Moſt of the Day was attended with Snow or Sleet.

The 8th in the Morning I found my Glaſs fallen to 28 Inches, 38 Parts, and at Four o'Clock *p. m.* down to 28 Inches, 5 Parts, and by Ten in the Evening riſen again to 28 Inches 45 Parts. All this while the Wind with us was in the North Eaſt, with only a moderate Gale, tho' attended all Day with Snow, which at Night was two Inches and a quarter deep; and about Eight it began to freeze. As the Wind in the South Parts was all that while in the oppoſite Quarter, I ſhould have expected an Accumulation of the Air, and, as a Conſequence, the riſing of the Barometer at the time of its falling the loweſt. Had the Storm been the Night before, when our Wind was in the ſame Direction, and had afterwards fallen, I ſhould then have imputed the Fall to the quick Return of the Current of Air to reſtore the Æquilibrium: But as it is, the ſmall Progreſs I have made in *Natural Philoſophy*, leaves me in Ignorance. I cannot conclude without once more asking Pardon for this Freedom, and aſſuring you that I am,

SIR,

Your moſt obedient, humble Servant,

HENRY FORTH.

P. S. As we have been fortunate in eſcaping the laſt Storm, we have been no leſs ſo in regard to the melancholy Effects which the great Rains have produced in the more Southerly Parts; for tho' we had more than uſual with us the laſt Mouth (for I find by my Regiſter that 13 ℔ 85 Pts. fell through my Funnel, whoſe Area is juſt 100 Inches, in *December* laſt) yet the almoſt conſtant intermitting Froſts we had, kept it from going off in any conſiderable Quantity at a time.

		Inches.
Barometer,	greateſt Altitude	30 : 10
	leaſt ditto	29 : 13

VIII. *An Account of the* Bones *of* Animals *being changed to a* Red Colour *by* Aliment *only. By* John Belchier, *Surgeon, F. R. S.*

THAT the Circulation of the Blood is carried on through the Bones, is evident from many Phœnomena obſervable in Surgery; but that the Circulation is univerſally and intimately diſtributed through the moſt ſolid and compact Subſtance of the Bones (tho' hitherto by ſome made a Matter of Doubt) will appear undeniably from the Inſtances here produced; which are the Bones of ſeveral Hogs, of a different Breed, changed to a deep red Colour meerly by Aliment. And what makes this ſtill more ſurpriſing is, that neither the fleſhy nor cartilaginous Parts ſuffer the leaſt Alteration in Colour or in Taſte.

The Diet with which theſe Hogs are fed is Bran, after it has been boiled in a Copper with printed Callicoes, in order to clean them from a dirty red Colour occaſioned by an Infuſion of *Madder Root*, which is made uſe of to fix the Colours printed on the Cloth; ſome of which Colours are made with Preparations from Iron, others with a Mixture of Alum and Sugar of Lead. The Parts printed with the Preparation of Iron produce Black and Purple; thoſe printed with the Mixture of Alum, Red of different Degrees, according to the Strength of the Mixture. The Bran having abſorbed the red Colour diſcharged from the Cloth, is mix'd with the common Food of the Hogs, and produces this Effect on their Bones.

Upon examining theſe Bones, I obſerve in general the ſolid Parts to be moſt tinctur'd, and the Teeth particularly, except the enamell'd Part, which is of a different Subſtance; and upon ſawing them through, I find the internal Parts equally tinged, except at the Ends of the Bones, where the Subſtance is more ſpongy. And in order to diſcharge the Colour, I have macerated them in Water for many Weeks together; have boil'd them often, and ſteeped them in Spirits, but all hath prov'd ineffectual; nor is the leaſt Tincture given to any of the Liquids, in which I have made Experiments.

Whether this Colour is produced from the *Madder* only, or from all the Colours blended together, I purpoſe to make further Experiments.

IX. *An* Obſervation *of a* white Liquor *reſembling Milk, which appeared inſtead of* Serum *ſeparated from the Blood after it had ſtood ſome time.*

By Alexander Stuart *M. D. Phyſician in Ordinary to her Majeſty, F. R. S. and of the College of Phyſicians,* London.

JOHN WICKS, Carver, in *Bromley-ſtreet*, about forty Years of Age, had been ill about three Weeks by a Loſs of Appetite and Indigeſtion, and at laſt a Pain and Diſtention of his Stomach, with a low Degree of an inflammatory Fever; his Tougue dry, rough, and of a ruſty brown Colour in the Middle, with a white ſoft Liſt on each Side; his Urine very high coloured, with a ſlimy Pink-coloured Settlement in great Quantity; Stools very yellow and looſe.

Eight Ounces of Blood being taken away, inſtead of *Serum* nothing appeared above the *Coagulum* but this white Liquor, reſembling Milk, which I poured off to the Quantity of four Ounces, or thereabouts. There was no Smell perceptible at firſt, but in ſix Days it began to have the Smell of rotten Eggs: It ſtood in a Room, where there was a Fire for ſome Hours of the Day, for three Weeks more, in which time it did not alter its Conſiſtence nor Smell.

He had eat very little for a Week before I firſt ſaw him ; and only a little of a Calf's Foot ſtew'd the Night before for Supper, and no Breakfaſt that Day. He was addicted to drinking of ſtrong Pale-Malt Liquor every Day in his Health.

If this be *Chyle*, it is a Subſtance very different from Milk, which is apt to turn ſour and thick by keeping, and never contracts the putrid Smell of rotten Eggs, as this did. Whether it be not *Chyle* turn'd putrid, and near to Purulency, by a long Circulation in the Blood-Veſſels, but not converted into Blood, through ſome Defect in the *Sanguification*, is a Queſtion which I doubt cannot be decided without more Obſervations and Experience.

The *Coagulum* of the Blood was covered with a ſizy Pellicle, about the Thickneſs of a Shilling. The red Part was of a grumous, tender, incoherent Conſiſtence.

Tho' he was much better in a Week's time, I order'd five Ounces of Blood to be taken away, to ſee what Change had been made, and found the *Coagulum* cover'd with a ſizy Pellicle to the Thickneſs of Half a Crown, the red Part of a due Conſiſtence, the *Serum* clear, without any *Chyle*.

The *Urine* became clear, and he recovered in about two Weeks after I ſaw him firſt.

X. *An* Account *of what was obſerv'd upon opening the Corpſe of a Perſon who had taken ſeveral Ounces of* crude Mercury *internally; and of a* Plumb-Stone *lodg'd in the Coats of the* Rectum. *Communicated in a Letter from the late Dr.* Madden, *Phyſician at* Dublin, *to Sir* Hans Sloane, *Bar. Preſ. R. S.*

SIR,

THE Internal Uſe of *crude Mercury* is become ſo frequent of late, that I believe it may produce ſome great Benefit to Mankind hereafter, if a careful Collection was made of all the extraordinary Caſes relating to the good or bad Effects of this Practice.

There are ſome Circumſtances in the following Caſe, which were not owing to the internal Uſe of *Mercury*; yet there are many others which were undoubtedly occaſioned by it.

Some time ago I was preſent, with Dr. *Robinſon*, and Mr. *Nichols*, our Surgeon-General, at the opening the Body of a Gentleman of Note in this Town, who, for ſeveral Years, had found great Difficulty in going to Stool. This Diſorder increaſed upon him towards the latter End of his Life, and he was ſeized with a violent Diſtemper, of which

I can give you no Deſcription, having never attended him.

In order to procure a Paſſage downward (which I ſuppoſe was a principal Complaint) he took, by the Advice of a Phyſician, ſince dead, ſeveral Ounces of *crude Mercury*, at different times, without any Relief, and at length died.

Upon opening the *Abdomen*, which was very much diſtended, there burſt forth a great Quantity of Wind, though the Guts and Stomach were not wounded.

The Stomach was empty; and upon opening it we found the inner Coat very much inflamed from one End to the other. We obſerved in ſeveral Places of the ſmall Guts, ſome ſcatter'd Grains of *crude Mercury*, and along with them we generally found a black gritty Powder, very like *Æthiops Mineral*, which was, without doubt, the *Mercury* changed into that Conſiſtence.

The *Colon* was diſtended, at its Origin, to twice the Thickneſs that an ordinary Man's Arm has about the Shoulder. This extraordinary Thickneſs extended itſelf about the Length of ten or twelve Inches; from hence it gradually decreaſed, and where it was attached to the Stomach, it had not above a third Part of that Size.

It was much inflamed at its Origin, and contained at leaſt ſix Quarts of liquid Excrement, in which we obſerved *crude Mercury*, and alſo ſome of the black Powder mentioned above.

The *Colon*, where it parted from the Stomach, and diverged toward the left Kidney, adhered about the Space of three Inches to the *Omentum*; and upon ſeparating the Adheſion, we found an Abſceſs and Inflammation, which had communicated itſelf to thoſe Parts of the *Ileon*, which were contiguous to the *Colon*.

The *Colon* had in this Place a Perforation about three Quarters of an Inch in Diameter, and four ſmaller Perforations, about the Size of a Gooſe's Quill, through which ſome Excrement had paſſed into the *Abdomen*.

The Coats of the *Colon*, as it approached the *Inteſtinum rectum*, began to grow ſcirrhous, about the Space of ſix Inches, and the Capacity became gradually ſmaller.

The Valves of the *Colon*, about this Place, were of a reddiſh Colour, and were more ſcirrhous than the other Parts of the *Inteſtine*. The Coats of the *Colon*, where it was continued to the *Rectum*, were at leaſt half an Inch thick, and its Capacity was not above the fourth Part of the natural Size.

Upon cutting the Gut horizontally hereabout, we perceived a Body which ſtopped the Paſſage, and ſeemed to the Touch almoſt of a cartilaginous Conſiſtence. Having opened the Gut Lengthways, we found it was no more than two of the *Valvulæ Conniventes Coli*, which were grown ſcirrhous, and were protruded downward into the *Rectum*.

We alſo found a ſmall *Plumb-Stone* in this Place, which was quite buried in the *Tunica Villoſa*, and had made itſelf a Bed between the Coats

of the *Rectum*. It had likewiſe formed a ſmall Abſceſs, which diſcharged itſelf into the Cavity of the *Pelvis*, but had not any Communication with the Cavity of the *Rectum*.

XI. *Obſervatio Eclipſeos Telluris* Romæ *habita in Ædibus Eminentiſſimi* Cardinalis DE-VIA v. Non. *i. e.* d. 3 Maij, N. S. Apr. 22. V. S. MDCCXXXIV. *per* Didacum de Revillas, *Abbat.* Hieronym. *R. S. S.* *&* Andream Celſium, *R. S. S. Aſtrom. Profeſſ.* Upſal. *R. S.* Suec. *Secr.*

Clariſſimo Præſtantiſſimoque Viro
EUSTACHIO MANFREDIO,
Didacus de Revillas, *Abbas* Hieronym.
S. P. D.

TUÆ erga me humanitatis, amoriſque erga Te mei recordationem in animo tuo excitandi, Ornatiſſime Manfredi, per opportunam ſuppeditat occaſionem Solaris Deliquii Obſervatio, quam in jucunda, tibique jam dudum familiari ſeveriorum Muſarum Diatriba, Ædibus nimirum Eminentiſſimi literatorum hominum Mœcenatis Cardinalis DE-VIA, diviſis officiis una cum Doctiſſimo, tuique amantiſſimo Andrea Celſio, Aſtron. Prof. Upſal. habuimus. Hanc ad Te mittendam communi conſilio cenſuimus; ut quemadmodum Cœli cum tuis Ephemeridibus mirum conſenſum noſtra hæc quoque Obſervatio probat; probes Tu num eadem ab Obſervationibus tuis minimè diſſentiat: quod ſanè ſperamus. Curam enimvero omnem, cum ex ſolaris ſpeciei ad Meridianam lineam appulſu, tum ex æqualibus Solis altitudinibus, eâdem obſervationis die, & pridie etiam ſæpius notatis, pro accurata temporis veri determinatione impenſam teſtari poſſumus. Cæterum duplici, notæ optimæ Teleſcopio palmarum Romanarum circiter VI, Telluris defectum obſervabamus (longiorum ſiquidem tuborum uſum nimia Solis ferè Meridiani altitudo, & alia quædam incomoda prohibebant): altero Solis imaginem directè ad oculum opacato vitro munitum tranſmittente, Eclipſeos præſertim initium & finem; altero in adverſà Tabellà, ut moris eſt, ſolarem ſpeciem depingente, Phaſes intermedias intuebamur. Spem equidem hujuſcemodi obſervationibus vacandi ademerant importunæ nubes, primùm oriente Sole auſtralem horizontis plagam, totum deindè Cœlum penè inficientes. At dum denſioribus rariores ſucceſſere, etſi primum Planetarum oſculum eripuerint, primas Phaſes aliquantulum incertas, & ſpeciem circa Eclipſeos finem veluti denticulatam exhibuerint; reliquas tamen obſervationes accuratè deſinire concedebant. Excipe ergo V. Cl. totius obſervationis ſeriem: & dum Literatorum omnium vota Te de Aſtronomia optimè meritum, incolumem, ſi unquam aliàs cupiunt, me ut ſoles amare perge.

Romæ IV Non. Maii MDCCXXXIV.

Obſer-

Obſervationes.	*Temp. ver. p.m. Diei* 2 *H.*	*'*	*''*	*Quantitas Obſcurationis Digit.*	
I	22.	22.	35	- - - - - -	*Initium aliquantum præceſſiſſe trans nubem videbatur.*
II		27.	1	0 ½	
III		34.	0	1	
IV		42.	6	1. ½	
V	23.	0.	52	2	
VI		3.	16	2 - - - - -	*Vel paullò plus: & max. obſcuratio imminens cenſebatur.*
VII		10.	31	2	
VIII		28.	16	1. ½	
IX		45.	11	0 ½	
X		52.	1	0 - - - - -	*Finis.*

Ex IV *&* VIII *Obſervat. maxima Obſcuratio circa h.* 23. *m.* 5. *colligitur.*

FINIS.

ERRATA.

Page 281. Line 1. for IV read V. P. 282. l. 7. for V. read VI.

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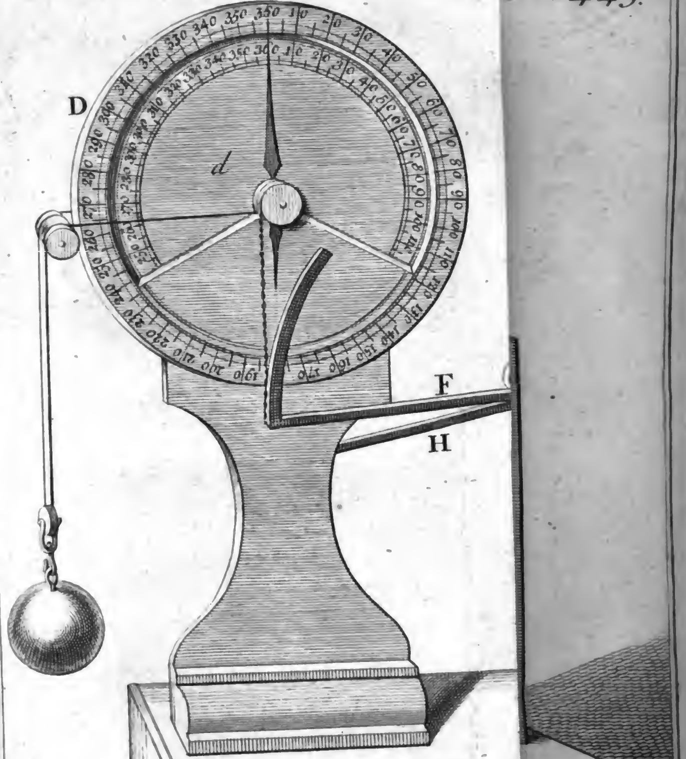

J. Mynde sculp.

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PHILOSOPHICAL TRANSACTIONS

For the Month of *October*, 1736.

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III. *The* Immerſions *and* Emerſions *of the four* Satellites *of* Jupiter; *for the Year* 1738. *computed to the Meridian of the* Royal Obſervatory *at* Greenwich, *by* James Hodgſon, *F. R. S. and Maſter of the Royal Mathematical School at* Chriſt'*s* Hoſpital, London.

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VI. *A* Narration *of the* Experiments *made* June 1, 1734. *before ſeveral Members of the* Royal Society, *and others, on a* Man, *who ſuffer'd himſelf to*

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VII. *A brief Account by Mr.* John Eames, *F. R. S. of a Work entitled,* The Method of Fluxions and Infinite Series, with its Application to the Geometry of Curve Lines, *by the Inventor Sir* ISAAC NEWTON, *Kt.* &c. *Tranſlated from the Author's Latin Original not yet made publick. To which is ſubjoin'd a perpetual Comment upon the whole,* &c. *by* John Colſon, *M. A. and F. R. S.*

VIII. *Of an* Inguinal Rupture, *with a* Pin *in the* Appendix Cœci, *incruſted with Stone; and ſome Obſervations on* Wounds *in the* Guts; *by* Claudius Amyand, *Eſq; Serjeant Surgeon to His* MAJESTY, *and F. R. S.*

IX. HERMANNI BOERHAAVE, *A. L. M. Philoſoph. & Med. Doct.* Medicinæ *in Univerſitate* Leidenſi *Profeſſ. Colleg. Chirurgic. Præſ.* Reg. Soc. Lond. *necnon* Reg. Scient. Acad. Pariſienſ. Soc. *de* MERCURIO Experimenta. Pars II.

X. ECLIPSIS LUNÆ *partialis die ſecundo* Octobris, *Styl. nov.* Anno MDCCXXXV. Vitembergæ Saxonum *obſervata à* Jo. Frider. Weidlero, *R. S. S.*

Printed for T. WOODWARD, at the *Half-Moon*, between the *Two Temple-Gates* in *Fleetſtreet*; and C. DAVIS, the Corner of *Pater-noſter-row*, next *Warwick-lane*. M.DCC.XXXVIII.

I. *The* Deſcription *and Manner of uſing an* Inſtrument *for meaſuring the Degrees of the* Expanſion *of* Metals *by Heat.*

By Mr. John Ellicott.

See the Fig. *prefix'd.*

A A is a flat Plate of Braſs, which, for farther Strength, is ſcrewed down to a thick Piece of Mahogany: Upon this Plate are ſcrewed three Pieces of Braſs, two of which, marked B B, ſerve as Supports for the flat Iron Bar C; and which, on account of its Uſe, I ſhall call the *Standard Bar*. The upper Part of the third Piece of Braſs is a Circle about three Inches Diameter, divided into 360 equal Parts or Degrees: Within this Circle is a moveable Plate, divided likewiſe into 360 Parts, and a ſmall Steel Index. The Braſs Circle in the *Fig.* is marked D, and the moveable Plate *d*. Upon the Standard Bar the Bar of Metal is laid, on which the Experiment is to be made, as E.

F is a Leaver 2 $\frac{1}{2}$ Inches in length, faſtened to an Axis, which turns in two Pieces of Braſs ſcrew'd to one of the Supports marked B: To the End of this Leaver is faſtened a Chain, or Silk Line, which, after being wound round a ſmall Cylinder, to which the Index in the Braſs Circle D is faſtened, paſſes over a Pulley, and has a Weight hung to the End of it: Upon the Axis, to which the Leaver is fixed, is a Pulley, $\frac{1}{4}$ of an Inch Diameter, to which a Piece of Watch-chain is faſtened; the other End of this Chain is hook'd to a ſtrong Spring, marked G, which Spring bears againſt one End of the Metal E.

H is a Leaver exactly of the ſame Form and Dimenſions with the former; but the Chain faſtened to the Pulley on its Axis is hook'd to the Standard Bar*. The Line faſten'd to the End of this Leaver, after being wound round a Cylinder, to which the moveable Plate is fixed, paſſes over a ſmall Pulley, and has a Weight hung to the End of it; or rather the ſame Line paſſing under a Pulley, to which the Weight is hung, has its other End faſtened to the Leaver F: Thus one Weight ſerves for both Leavers, as in the *Figure*.

From this Deſcription it is plain, that whenever the Bar E is lenghten'd, it gives Liberty to the Weight to draw the Leaver F upwards by its Action on the Spring G; and the Index will, at the ſame time, by Means of the Silk Line, be carried forward in the Circle; and as the Bar ſhortens, it will return back again; the ſame Motion will be communicated to the Standard Bar.

The Lengthening the Bar the $\frac{1}{20}$ of an Inch, will carry the Index once round the Braſs Circle, which is divided into 360 Degrees; therefore, if the Metal lengthens the 7200th Part of an Inch, the Index will move one Degree.

To make an Experiment with this *Inſtrument*, lay a Bar of any kind of Metal, as E, on the Standard Bar; then heat the Standard Bar to any Degree of Heat with a Lamp, and mark the Degree of its Expanſion as marked by the moveable Plate: Obſerve alſo the Degree of Expanſion of the Metal E, by the Heat communicated to it from the Standard Bar, as mark'd on the Braſs Circle by the Index: Let the *Inſtrument* ſtand, till the whole is thoroughly cold; then removing the Bar E, lay a Bar of any other Metal in its Place, and heat the Standard Bar to the ſame Degree of Heat as before, which is ſeen by the moveable Plates marking the ſame Degree of Expanſion. Then the Index will ſhew the Degree of Expanſion of the ſecond Metal, as it did of the firſt; and, by this Means, the Degrees of Expanſion of different Metals by the ſame Degree of Heat, may be exactly eſtimated.

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* *N. B.* The Chain to the former Pulley being faſten'd to a Spring, and not directly to the Metal E, is only for the more eaſy ſhifting the Metals.

II. *A further Account of the* Bones *of* Animals *being made* Red *by* Aliment *only. By* John Belchier, *F. R. S.*

IN the former Account, which I gave concerning the *Red Bones* of the *Hogs*, (ſee N°442. *p.*286.) I mention'd, That the Colour was occaſion'd by Bran, (being mix'd with their common Food) after it had been made Uſe of to clean printed Callicoes; the Colours of which were made, ſome from Preparations of *Iron*, which were the Blacks and Purples; others from Preparations of *Alum*, and *Sacc. Saturni*, which produces the Red Colours; and that *Madder* Root was made Uſe of to fix theſe Colours on the Cloth.——To which of theſe Preparations the Colour was owing, I could not determine. Some were of Opinion, that it was intirely occaſion'd by the Preparations of *Iron*; others, that it was the whole blended together; And, in order to clear up this Point, I determin'd to make ſome Experiments. The firſt I made was upon a Cock, by mixing ſome of the *Madder* Root with *Fig Duſt*, on which they feed.——The Cock dying within ſixteen Days after his firſt feeding on the *Madder*, I diſſected him, and examin'd the Bones, not in the leaſt Expectation of finding them ting'd in ſo ſmall a Time; but, to my great Surprize, found them univerſally of a Red Colour: So that, from this Experiment, it appears, that the *Madder* alone cauſes this Alteration: But why the Bones only are affected, I ſhall conſider of in the Courſe of more Experiments.

III. *The* Immerſions *and* Emerſions *of the four* Satellites *of* Jupiter, *for the Year* 1738. *computed to the Meridian of the* Royal Obſervatory *at* Greenwich, *by* James Hodgſon, *F. R. S. and Maſter of the Royal Mathematical School at* Chriſt's Hoſpital, London.

ECLIPSES *of the firſt* Satellite *of* JUPITER.

D.	H.	M.		D.	H.	M.		D.	H.	M.	
JANUARY.				FEBRUARY.				MARCH.			
Emerſions.				Emerſions.							
3	5	16	M	2	7	21	M	On the 15th of March Jupiter and the Sun will be in Conjunction.			
4	11	45	A	4	1	50	M				
6	6	13	A	5	8	19	A				
8	0	41	A	7	2	48	A				
10	7	10	M	9	9	17	M				
12	1	38	M	11	3	46	M				
13	8	6	A	12	10	15	A	APRIL.			
15	2	35	A	14	4	44	A				
17	9	3	M	16	11	13	M	Immerſions.			
19	3	32	M	18	5	42	M				
20	10	0	A	19	12	11	A	10	11	38	M
22	4	29	A	21	6	41	A	12	6	7	M
24	10	57	M	23	1	10	A	14	0	36	M
26	5	26	M	25	7	39	M	15	7	5	A
27	11	55	A	27	2	8	M	17	1	34	A
29	6	24	A					19	8	3	M
31	0	53	A					21	2	32	M

22

ECLIPSES *of the firſt* Satellite *of* JUPITER.

D.	H.	M.	
22	9	1	A
24	3	30	A
26	9	58	M
28	4	27	M
29	10	56	A

MAY.

Immerſions.

D.	H.	M.	
1	5	24	A
3	11	53	M
5	6	22	M
7	0	50	M
8	7	19	A
10	1	47	A
12	8	16	M
14	2	44	M
15	9	13	A
17	3	41	A
19	10	9	M
21	4	38	M
22	11	6	A
24	5	34	A
26	0	3	A
28	6	31	M
30	0	59	M
31	7	27	A

JUNE.

Immerſions.

D.	H.	M.	
2	1	55	A
3	20	24	A
6	2	52	M
7	9	20	A
9	3	48	A
11	10	16	M
13	4	44	M
14	11	13	A
16	5	41	A
18	0	9	A
20	6	37	M
22	1	5	M
23	7	34	A
25	2	2	A
27	8	30	M
29	2	59	M
30	9	27	A

JULY.

Immerſions.

D.	H.	M.	
2	3	55	A
4	10	24	M
6	4	52	M
7	11	20	A
9	5	49	A
11	0	17	A
13	6	46	M
15	1	14	M
16	7	42	A
18	2	11	A
20	8	40	M
22	3	8	A
23	9	37	A
25	4	6	A
27	10	34	M
29	5	3	M
30	11	32	A

AUGUST.

Immerſions.

D.	H.	M.	
1	6	1	A
3	0	29	A
5	6	58	M
7	1	27	M
8	7	56	A
10	2	25	A
12	8	54	M
14	3	23	M
15	9	52	A
17	4	21	A
19	10	50	M
21	19	5	M
24	6	18	A
26	0	47	A

ECLIPSES *of the firſt* Satellite *of* JUPITER.

D.	H.	M.
28	7	16 M
30	1	45 M
31	8	14 A

SEPTEMBER.

Immerſions.

D.	H.	M.
1	2	44 A
4	9	13 M
6	3	42 M
7	10	11 A
9	4	40 A
11	11	10 M
13	5	39 M
15	0	8 M
16	6	37 A
18	1	7 A
20	7	36 M
22	2	5 M
23	8	34 A
25	3	3 A
27	9	32 M
29	4	2 M
30	10	11 A

OCTOBER.

Immerſions.

D.	H.	M.
2	5	0 A
4	11	29 M
6	5	58 M.

Emerſions.

D.	H.	M.
8	2	36 M
9	9	5 A
11	3	34 A
13	10	2 M
15	4	31 M
16	11	0 A
18	5	29 A
20	11	58 M
22	6	27 M
24	0	56 M
25	7	24 A
27	1	53 A
29	8	22 M
31	2	50 M

NOVEMBER.

Emerſions.

D.	H.	M.
1	9	19 A
3	3	47 A
5	10	16 M
7	4	44 M
8	11	13 A
10	5	41 A
12	0	9 A
14	6	38 M
16	1	6 M
17	7	34 A
19	2	2 A
21	8	30 M
23	2	59 M
24	29	27 A
26	3	55 A
28	10	23 M
30	4	55 M

DECEMBER.

Emerſions.

D.	H.	M.
1	11	19 A
3	5	47 A
5	0	15 A
7	6	43 M
9	1	11 M
10	7	39 A
12	2	7 A
14	8	35 M
16	3	3 M
17	9	31 A
19	3	59 A
21	10	27 M
23	4	56 M
24	11	23 A
26	5	51 A
28	0	19 A
30	6	48 M

ECLIPSES *of the ſecond* Satellite *of* JUPITER.

JANUARY.

Emerſions.

D.	H.	M.	
2	0	59	M
5	2	17	A
9	3	34	M
12	4	52	A
16	6	9	M
19	7	27	A
23	8	45	M
26	10	4	A
30	11	22	M

FEBRUARY.

Emerſions.

D.	H.	M.	
3	0	41	M
6	1	59	A
10	3	18	M
13	4	37	A
18	5	56	M
20	7	14	A
24	8	34	M
27	9	54	A

MARCH.

On the 15th of March Jupiter and the Sun will be in Conjunction.

APRIL.

Immerſions.

D.	H.	M.	
11	11	6	M
15	0	25	M
18	1	44	A
22	3	3	M
25	4	21	A
29	5	40	M

MAY.

Immerſions.

D.	H.	M.	
2	6	58	A
6	8	16	M
9	9	34	A
13	10	52	M
17	0	10	M
20	1	27	A
24	2	45	M
27	4	2	A
31	5	20	M

JUNE.

Immerſions.

D.	H.	M.	
3	6	37	A
7	7	55	M
10	9	12	A
14	10	29	M
17	11	46	A
21	1	4	A
25	2	21	M
28	3	39	A

JULY.

Immerſions.

D.	H.	M.	
1	16	56	A
5	6	14	A
9	7	31	M
12	8	49	A
16	10	7	M
19	11	25	A
23	0	44	A
27	2	2	M
30	3	20	A

AUGUST.

Immerſions.

D.	H.	M.	
3	4	39	M
6	5	58	A
7	7	16	A
13	8	35	A
17	9	54	M
20	11	13	A
24	0	33	A
28	1	52	M
31	3	11	A

ECLIPSES *of the ſecond* Satellite *of* JUPITER.

D.	H.	M.	
SEPTEMBER.			
Immerſions.			
4	4	31	M
7	5	50	A
11	7	9	M
14	8	29	A
18	9	48	M
21	11	7	A
25	0	27	A
29	1	46	M
OCTOBER.			
Immerſions.			
2	3	5	A
6	4	24	M
Emerſions.			
9	8	17	A
13	9	36	M
16	10	54	A
20	0	13	A
24	1	31	M
31	4	8	M
NOVEMBER.			
Emerſions.			
3	5	26	A
7	6	43	M
10	8	1	A
14	9	19	M
17	10	36	A
21	11	53	M
26	1	10	A
28	2	27	A
DECEMBER.			
Emerſions.			
2	3	44	M
5	5	1	A
9	6	18	M
12	7	35	A
16	8	52	M
19	10	9	A
23	11	26	M
27	0	43	M
30	2	0	A

ECLIPSES *of the third* Satellite *of* JUPITER.

JANUARY.

Immerſions.

D.	H.	M.	
8	11	48	M
15	3	48	A
22	7	49	A

Emerſions.

D.	H.	M.	
8	2	39	A
15	6	38	A
22	10	38	A
30	2	39	M

FEBRUARY.

Immerſions.

Emerſions.

D.	H.	M.	
6	6	41	M
13	10	43	M
20	2	45	A
27	6	48	A

MARCH.

Immerſions.

March the 15th Jupiter and the Sun will be in Conjunction.

Emerſions.

APRIL.

Immerſions.

D.	H.	M.	
11	4	27	A
18	8	30	A
26	0	33	M

Emerſions.

MAY.

Immerſions.

D.	H.	M.	
3	4	34	M
10	8	35	M
17	0	36	A
24	4	36	A
31	8	36	A

Emerſions.

D.	H.	M.	
3	7	9	M
10	11	10	M
17	3	9	A
24	7	9	A
31	11	8	A

JUNE.

Immerſions.

D.	H.	M.	
8	0	36	M
15	4	35	M
22	8	35	M
29	0	35	A

Emerſions.

D.	H.	M.	
8	3	6	A
15	7	5	M
22	11	4	M
29	3	3	A

Eclipses *of the third* Satellite *of* Jupiter.

July.

Immerſions.

D.	H.	M.	
6	4	35	A
13	8	36	A
21	0	37	M
28	4	38	M

Emerſions.

D.	H.	M.	
6	7	3	A
13	11	2	A
21	3	2	M
28	7	3	M

August.

Immerſions.

D.	H.	M.	
4	8	40	M
11	0	43	A
18	4	46	A
25	8	49	A

Emerſions.

D.	H.	M.	
4	11	5	M
11	3	6	A
18	7	9	A
25	11	11	A

September.

Immerſions.

D.	H.	M.	
2	0	53	M
9	4	57	M
16	9	0	M
23	1	4	A
30	5	6	A

Emerſions.

D.	H.	M.	
2	3	14	M

October.

Immerſions.

D.	H.	M.	
7	9	11	A

Emerſions.

D.	H.	M.	
7	11	28	A
15	3	30	M
22	7	32	M
29	11	33	M

November.

Immerſions.

D.	H.	M.	
5	1	18	A
12	5	18	A
19	9	18	A
27	1	17	M

Emerſions.

D.	H.	M.	
5	3	33	A
12	7	33	A
19	11	32	A
27	3	31	M

December.

Immerſions.

D.	H.	M.	
4	5	16	M
11	9	14	M
18	1	13	A
25	5	12	A

Emerſions.

D.	H.	M.	
4	7	29	M
11	11	28	M
18	3	26	A
25	7	24	A

January the 1*ſt*, at 8 h. 28 m. in the Evening, the fourth *Satellite* of *Jupiter* will Immerge into the Shadow, and at 9 h. 49 m. it will Emerge out of the Shadow.

Again, on the 18*th* Day there will be an Immerſion at 2 h. 55 m. in the Afternoon, and at 3 h. 48 m. the Emerſion will happen.

Again, on the 4*th* of *February*, at 9 h. 31 m. in the Morning, the fourth *Satellite* will Immerge into the Shadow of *Jupiter*, and at 9 h. 44 m. the ſame Morning, *it* will Emerge out of the Shadow.

And after this Time, the fourth *Satellite* will paſs wide of the Shadow till the 24*th* Day of *June* 1740; when the Immerſion will happen at 8 h. 43 m. in the Evening, and the Emerſion at 10 h. 15 m. the ſame Evening.

IV. *The apparent Times of ſuch of the* Immerſions *and* Emerſions *of* Jupiter*'s Satellites, as are viſible at* London, *in the Year* 1738. *By the Same.*

	D.	H.	M.			
	JANUARY.					
1	1	8	29	A	I.	4
2	6	6	13	A	E.	1
3	12	4	52	A	E.	2
4	13	8	6	A	E.	1
5	15	6	38	A	E.	3
6	19	7	27	A	E.	2
7	22	4	29	A	E.	1
8	22	7	49	A	E.	3
9	29	6	24	A	E.	1
	FEBRUARY.					
10	13	4	37	A	E.	2
11	21	6	41	A	E.	1
12	27	6	48	A	E.	3
	APRIL.					
13	28	4	27	M	I.	1
	MAY.					
14	14	2	44	M	I.	1
15	24	2	55	M	I.	2
	JUNE.					
16	6	2	52	M	I.	1
17	8	3	6	M	I.	3
18	22	1	6	M	I.	1
19	25	2	21	M	I.	2
20	29	2	59	M	I.	1
	JULY.					
21	7	11	20	A	I.	1
22	13	11	2	A	I.	3
23	15	1	40	M	I.	1
24	19	11	25	A	I.	2
25	21	0	37	M	I.	3
26	21	3	2	M	E.	3
27	22	3	8	M	I.	1
28	27	2	2	M	I.	2
29	30	11	32	A	I.	1
	AUGUST.					
30	3	4	39	M	I.	2
31	7	1	27	M	I.	1
32	13	8	35	A	I.	2
33	14	3	23	M	I.	1
34	15	9	52	A	I.	1
35	20	11	13	A	I.	2

	D.	H.	M.			
36	22	11	48	A	I.	1
37	25	8	49	A	I.	3
38		11	11	A	E.	3
39	28	1	52	M	I.	2
40	30	1	45	M	I.	1
41	31	8	14	A	I.	1

SEPTEMBER.

	D.	H.	M.			
42	2	0	53	M	I.	3
43		3	14	M	E.	3
44	4	4	30	M	I.	2
45	6	3	42	M	I.	1
46	7	10	11	A	I.	1
47	9	4	57	M	I.	3
48	13	5	39	M	I.	1
49	14	8	29	A	I.	2
50	15	0	8	M	I.	1
51	16	6	37	A	I.	1
52	21	11	7	A	I.	2
53	22	2	5	M	I.	1
54	23	8	34	A	I.	1
55	29	1	46	M	I.	2
56	29	4	2	M	I.	1
57	30	10	31	A	I.	1

OCTOBER.

	D.	H.	M.			
58	6	4	24	M	I.	2
59	6	5	58	M	I.	1
60	7	9	11	A	I.	3
61	7	11	28	A	E.	3
62	8	2	36	M	E.	1
63	9	8	17	A	E.	2
64	9	9	5	A	E.	1
65	15	3	30	M	E.	3
66	15	4	31	M	E.	1
67	16	10	54	A	E.	2
68	16	11	0	A	E.	1
69	18	5	29	A	E.	1
70	22	6	27	M	E.	1
71	24	0	50	M	E.	1
72	24	1	31	M	E.	2
73	25	7	24	A	E.	1
74	31	2	50	M	E.	1
75	31	4	8	M	E.	2

NOVEMBER.

	D.	H.	M.			
76	1	9	19	A	E.	1
77	3	5	26	A	E.	2
78	7	4	44	M	E.	1
79	8	11	13	A	E.	1
80	10	5	41	A	E.	1
81	10	8	1	A	E.	2
82	12	5	18	A	I.	3
83		7	33	A	E.	3
84	16	1	6	A	E.	1
85	17	7	34	A	E.	1
86	17	10	36	A	E.	2
87	19	9	18	A	I.	3
88		11	32	A	E.	3
89	24	9	27	A	E.	1
90	26	1	11	M	E.	2
91	27	1	17	M	E.	3

DECEMBER.

	D.	H.	M.			
92	1	11	19	A	E.	1

	D.	H.	M.			
93	3	5	47	A	E.	1
94	5	5	1	A	E.	2
95	9	1	11	M	E.	1
96	10	7	39	A	E.	1
97	12	7	35	A	E.	2
98	17	9	31	A	E.	1
99	19	4	0	A	E.	1
100	19	10	9	A	E.	2
101	24	11	23	A	E.	1
102	25	5	12	A	I.	3
103	25	7	24	A	E.	3
104	26	5	51	A	E.	1
105	27	0	43	M	E.	2

In all 105.

The 2*d*, 5*th*, 8*th* and 11*th* Columns, ſhew the Times when the Eclipſes will happen; the 3*d*, 6*th*, 9*th* and 12*th*, the Kind. Thus, on the 1ſt of *January*, at 8 h. 29 m. in the Afternoon or Evening, there will happen an Immerſion of the fourth *Satellite* of *Jupiter*: On the 6th, at 6 h. 13 m. an Emerſion of the firſt, *&c.*

V. *Part*

V. *Part of a Letter from* William Burton, *M. D. at* Windſor, *to* C. Mortimer, *R. S. Secr. concerning the* Viper-catchers, *and their* Remedy *for the* Bite *of a* Viper.

SIR, *Windſor, May* 24, 1734.

THE Bearer of this, *William Oliver*, and his Wife, called upon me laſt Week with their *Vipers*, and either of them offered to be bit by any *Viper*, and to ſuffer their Arm to ſwell for ſome Time; and then, by the external Application of a common cheap Remedy, in a few Hours to remove all the Symptoms. The Experiment was made laſt *Wedneſday* in our Town-Hall, before Dr. *Derham*, F. R. S. Dr. *Waterland*, the Phyſicians, Apothecaries, and Chirurgeons of this Town, and many other Gentlemen of this Neighbourbood. He was bit in the upper Joint of the Thumb, and higher up on the ſame Arm, by two different freſh *Vipers*: His Thumb, Hand and Arm ſoon after ſwelled much, and all the uſual Symptoms of a *Viper-bite* followed; he applied the Remedy [*Sallad-Oil*] before us, with the promiſed Succeſs: But all the Contributors engaged not to divulge the Remedy * * *.

Yours, &c.

WILLIAM BURTON.

VI. *A*

VI. *A* Narration *of the* Experiments *made* June 1, 1734. *before ſeveral Members of the* Royal Society, *and others, on* a Man, *who ſuffer'd himſelf to be* bit by a Viper, *or* common Adder; *and on* other Animals *likewiſe bitten by the ſame, and other* Vipers. *Drawn up by* Cromwell Mortimer, *M. D. Secr. R. S. With ſome Remarks on* the Cure of the Bite of a Mad Dog.

William Oliver and his Wife, from *Bath*, who follow the Buſineſs of catching and ſelling *Vipers*, offered themſelves to be bit by any *Viper* that ſhould be procured, truſting to the Virtue of a Remedy they had lighted on by chance in trying Variety of Things, when the Woman was once accidentally bitten, and the uſual known Medicines, even the *Oil of Vipers*, had no Effect in aſſwaging her Pains, eſpecially of her Breaſt of the ſame Side as the Hand in which ſhe had received the Wound. This Remedy, which is only common OIL of OLIVES, and, from its Uſe with *Sallad*, is vulgarly known by the Name of *Sallad-Oil*, recommends itſelf not only for its Efficacy, but likewiſe on account of its being readily to be come at, when Accidents happen, there being no Town, or even Gentleman's Houſe in the Country, where *Sallad-Oil* is not at hand; whereas the *Oil of Vipers* is never to be had, but at *Apothecaries*,

caries, and not one in an Hundred of them keep it by them.

On the firſt of *June* 1734, in the Preſence of a great Number of Perſons, the ſaid *William Oliver* was bit by an old black *Viper*, or *Adder*, brought by one of the Company, upon the Wriſt and Joint of the Thumb of the Right Hand, ſo that Drops of Blood came out of the Wounds. He ſaid that he immediately felt a violent Pain and ſhooting from the Wounds, both to the Top of his Thumb and up his Arm, even before the *Viper* was looſen'd from his Hand; ſoon after he felt a Pain, reſembling that of burning, trickle up his Arm; in a few Minutes his Eyes began to look red and fiery, and to water much: In leſs than half an Hour, he perceived the Venom ſeize his Heart, with a pricking Pain, which was attended with Faintneſs and Shortneſs of Breath, whereupon he fell into violent cold Sweats: In a few Minutes after this, his Belly began to ſwell, with great Gripings, and Pains in his Back, which were attended with violent Vomitings and Purgings. He told me, that, during the Violence of theſe Symptoms, his Sight was gone twice for ſeveral Minutes at a Time, but that he could hear all the while. He ſaid, that in his former Experiments he had never deferr'd making uſe of his Remedy longer than when he perceived the Effects of the Venom reaching his Heart; but this Time, being willing to ſatisfy the Company thoroughly, and truſting to the ſpeedy Effects of the *Oil*, which had never failed him, when uſed in Time, he forbore to apply any thing, till he found himſelf exceeding ill, and quite giddy.

About an Hour and Quarter after the firſt of his being bit, a Chafing-diſh of glowing Charcoal was brought in, and his Arm, the Cloaths being ſtript off of it, was held over it as near, as he could bear it, while his Wife rubb'd in with her Hand the *Sallad-Oil*, (which I had procured and kept myſelf in my Pocket, leſt they ſhould privately add any Thing to it; I bought it by the Name of *Lucca-Oil*) turning his Arm continually round, as if ſhe would have roaſted it over the Coals: He ſaid that the Pain ſoon abated, but the Swelling did not diminiſh much; moſt violent Vomitings and Purgings ſoon enſued, and his Pulſe became ſo low, and ſo often interrupted, that it was thought proper by the Phyſicians preſent, to give him the following Cordial Draughts, at about a quarter of an Hour's Diſtance between each.

1. ℞. *Aq. Lact. Pæon. comp.* $\overline{aa}$. ℥iij. *Sp. Lavendulæ* ʒi. *m. pro duobus Hauſtibus.*
2. ℞. *Confect. Raleigh.* ʒſs. *Aq. Theriacal.* ℥iſs. *Sp. C. C.* g$^{tt.}$ x. *m. f. Hauſtus.*
3. ℞. *Confect. Raleigh. Theriac. Andromach.* $\overline{aa}$. ʒſs. *Sal. C. C. gr.* v. *Aq. Theriacal.* ℥ij. *pro duobus Hauſtibus.*

He ſaid he was not ſenſible of any great Relief from theſe Cordials; but that a Glaſs or two of *Olive-Oil* drank down, ſeemed to give him ſome Eaſe.

Continuing in this dangerous Condition, he was put to Bed as ſoon, as one could be got ready for him, where his Arm was again bathed with his Remedy over a Pan of Charcoal ſet by the Bed-ſide: But continuing to complain much of his Back and Belly, I adviſed his Wife to rub them likewiſe with *Sallad-Oil*, heated in a Ladle over the Charcoal; which ſhe did accordingly: whereupon he declared he found immediate Eaſe, as tho' by ſome Charm; and he had not above two or three Reachings to vomit and Stools afterwards, but made Water plentifully, which was not diſcolour'd: Then he ſoon fell into a ſound Sleep, only was often interrupted by Perſons coming to ſee and inquire after him, till near Twelve o'Clock, from which Time he ſlept continually to Five or Six next Morning, when he awaked, and found himſelf very well: But in the Afternoon, on drinking ſome Rum and ſtrong Beer, ſo as to be almoſt fuddled, the Swelling returned, with much Pain, and cold Sweats; which abated ſoon, on bathing the Arm as before, and wrapping it up in brown Paper ſoaked with *Oil*.

Two *Pidgeons* were bit by the ſame *Viper* immediately after the Man: They ſoon ſicken'd, and ſeem'd giddy. Nothing being applied, the one died in about an Hour's Time, the other half an Hour after. The Fleſh of both was turn'd quite black, as if mortified; the Blood was coagulated, and looked black.

On the 3d of *June*, the Man's Arm remain'd ſwelled, looked red, marbled with Spots of Yellow, but felt ſoft; and he had the perfect Uſe of it, and even of his Fingers, no Pain or Stiffneſs being left. He then cauſed a ſmall *Spaniel Dog* to be bit on the Noſe by a freſh *Viper*: Some *Oil* was immediately applied hot, and rubbed well in, till all the Hair of his Noſe was thoroughly wet: The *Dog* did not ſeem very uneaſy; his Noſe only ſwelled a little; he eat ſoon after; his Noſe was bathed once more that Evening; he was found very well next Morning; but his Noſe was bathed again, to make ſure of his Cure: He remain'd perfectly well without any Symptoms enſuing, and was alive and well a Year after. Another *Pidgeon* was likewiſe bit under the Wing at the ſame Time as the *Dog*, but by a freſh *Viper*; the *Oil* was immediately applied hot, and rubbed well in, and the Feathers of the Wing were thoroughly wetted with it. This Bird did not ſeem at all diſordered with the Venom, but eat ſoon after, and was found well the next Morning, without any remarkable Inflammation or Swelling about the Part. The hot *Oil* was rubbed in again for two or three Days, twice a Day, and the Bird continued well, ſo that the *Viper-catchers* carried it with them out of Town in Triumph, having never before experienced the Efficacy of their Remedy on ſo ſmall an Animal; which, as it receives the ſame Quantity of Venom by a Bite as a larger one doth, is more liable to die under it; and they kept it alive above three Months, when they killed it and eat it. They ſaid that they had experienced their Remedy to take Effect on *Cows*, *Horſes*, and *Dogs*, ten Hours after being bit; but that for themſelves, who are frequently bit in the Fields, as they catch the *Vipers*, they always carry a Vial of *Sallad-Oil* along with them, that, as ſoon as they perceive themſelves wounded, they without any Loſs of Time bathe the Part with it; and if it be the Heel, they wet the Stocking thoroughly with it; if the Finger, which happens ofteneſt, they pour ſome of it into that Finger of their Glove, which they immediately put on again, and thus never feel any farther Inconvenience from the Accident, not even ſo much as from the Sting of a common *Bee*. Perhaps it may be found of Uſe for the Bite of ***Rattle-Snakes***, and other venomous Animals; eſpecially if we conſider, that in the Fields a Man ſeldom or never receives more than one Bite at a Time, which doth not infect him with ſo much Venom, as was inſtilled into the Man's Blood, when in theſe voluntary Experiments he ſuffer'd himſelf to be bitten twice together; and had likewiſe been bitten three times but about a Week or ten Days before; ſome Remains of which Venom, it is highly reaſonable to imagine, might ſtill infect his Blood at the Time he repeated the Experiments, ſo as to make a freſh Quantity of the Venom operate with greater Violence upon his Body, than if he had been quite a freſh Man, never infected with the like Poiſon before, or at leaſt at ſo great an Interval of Time, that his Blood might have been intirely free from all Remains of ſuch an acrid Infection. From theſe Experiments is it not reaſonable to imagine, that the *Oil* by itſelf may be as efficacious againſt the Sting of a *Scorpion*, as if *Scorpions* were infuſed in it?

I ſhould not have forborn ſo long imparting the Knowledge of ſo uſeful a Remedy to the Publick, had not the poor People injoined every one preſent at the Experiments not to divulge, what their Remedy was, till they ſhould give me Leave to make it publick in theſe Papers, which they have now done. The Reaſon of their keeping it a Secret, was the Hopes of obtaining an handſome Reward from generous and charitable People; but now having loſt all Proſpect of any conſiderable Recompenſe, they were unwilling that the Means of immediate Relief to thoſe, who ſhould have the Misfortune of being bit by an *Adder*, ſhould any longer be withheld from them; and they are deſirous, that this their REMEDY againſt the BITE of the VIPER may be as publickly known as the famous DAMPIER'S POWDER againſt the BITE of a MAD DOG, firſt publiſhed by Sir *Hans Sloane*, Bart. when *Secr. R. S.* in Numb. 237. of theſe *Tranſactions*, *Anno* 1698. * which afterwards, when he was Preſident of the Royal College of Phyſicians *London*. by his Propoſal, was introduced into the *London Pharmacopœia*, under the Name of *Pulvis Antilyſſus*, *Anno* 1720. The Compoſition of which is, *Aſh-colour'd Ground Liver-wort* and *black Pepper*: The Manner of giving it, not only to Men, but to Dogs and Cattle, being accurately ſet down in the above-mentioned Number 237. of theſe *Tranſactions*, in a Letter from Mr. *George Dampier*, dated *Exmouth*, *Nov.* 10, 1697. to his Brother Capt. *William Dampier*, the famous Sailor, I muſt refer ſuch as have Occaſion to give it, to that Paper. Thus I hope, that *certain Cures* are diſcovered for the only two Sorts of *venomous Bites* of Animals, to which the happy Soil of *Great Britain* expoſes its Inhabitants.

I ſhall only beg Leave to add a Propoſal of my own, which I made in my *Theſ. Inaugur. de Ingreſſu Humorum in Corpus Humanum*, *Ludg. Bat.* 1724. That the Uſe of the hot Bath, for Perſons bit by a *Mad Dog*, or hot Fomentations, might be of greater Service than cold Applications: For a cold Bath ſhuts the Pores, as a warm one opens them; therefore the Blood being allowed to be greatly inflamed in this Caſe, and *Dampier*'s *Powder* being a very hot Medicine, it is reaſonable to think, that when a Patient takes it, the ſetting him up to the Chin in hot Water for ſome Hours, would help the Operation of the *Powders*, by diluting the Blood, and relaxing the Pores.

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* The *Lichen cinereus terreſtris* is mentioned as *being ſaid to be exceedingly efficacious in curing* Dogs *bitten by* Mad Dogs; in a Letter of Mr. *Oldenburgh*'s, Secr. R. S. *Lond. July* 6, 1672. See *Derham*'s Collection of *Philoſop. Letters* between Mr. *Ray* and his *Correſpondents*, p. 110. printed at *London*, 1718. 8vo.

VII. *A brief Account by Mr.* John Eames, *F. R. S. of a Work entitled*, The Method of Fluxions and Infinite Series, with its Application to the Geometry of Curve Lines, *by the Inventor Sir* Iſaac Newton, *Kt.* &c. *Tranſlated from the Author's Latin Original not yet made publick. To which is ſubjoin'd a perpetual Comment upon the whole*, &c. *by* John Colſon, *M. A.* and *F. R. S.*

THIS Poſthumous Work of our late excellent Preſident, a Tranſlation of which we have now received from the Hand of the learned and ingenious Mr. *Colſon*, has been long and impatiently expected by the curious in theſe Matters; and now it appears, I believe it will fully anſwer, if not exceed, thoſe Expectations, as well as confirm the Reputation the Author has ſo juſtly acquired by his other Writings. For it is wrote with the ſame Genius and *Acumen*, it explains the Principles of his Method of Fluxions with great Clearneſs and Accuracy, and applies thoſe Principles to very general and ſcientifical Speculations in the higher Geometry. And farther to explain this Work, and to ſupply ſuch Things, for the Uſe of common Readers, which the Author, according to his uſual Brevity, has often omitted; the Tranſlator has thought fit to give us a Comment on a good Part of the Work, and has promiſed the reſt at a proper Seaſon. His Fitneſs for ſuch an Undertaking is well known to the learned World, into which he was many Years ago introduced by a very good Judge, as a Perſon who was *reconditioris Analyſeos peritiſſimus.*

This Text may very well be divided into three Parts: An Introduction, containing the Method of Infinite Series; The Method of Fluxions and Fluents; and laſtly, The Application of both to the moſt conſiderable Problems of the higher Geometry. The Comment conſiſts of very valuable and curious Annotations, Illuſtrations, and Supplements, in order to make the whole a *compleat Inſtitution* for the Uſe of Learners. I ſhall take a kind of comparative View of the Text and Comment together.

The great Author, in what is called the Introduction, teaches the Rudiments of his Method of Infinite Converging Series, which is preparatory to that of Fluxions. In this he ſhews how all Compound Algebraical Quantities may be reſolved into Series of ſimple Terms, which will converge to thoſe compound Quantities, or rather to their Roots; juſt as in common Decimal Arithmetick, any complicate Number whatever, rational or ſurd, may be proſecuted and exhibited to what Degree of Accuracy we pleaſe, by decimal Parts continued *in infinitum*. And this general Arithmetick is here applied to the finding of the Roots of all kinds of Algebraical Equations, whether pure or affected.

And this Doctrine is carried on ſtill farther by Mr. *Colſon* in his Comment. He purſues the Author's Hint, that vulgar Arithmetick and Algebra, decimal Fractions and infinite Series, have the ſame common Foundation, and compoſe together but one uniform Science of Computation. For, as in our vulgar Arithmetick, when rightly explain'd, we expreſs and compute all Numbers by the Root *Ten*, and its ſeveral Powers and their Reciprocals, together with a Set of certain known and ſmall Coefficients; ſo in this more univerſal Arithmetick of Infinite Series, we do the ſame thing in effect, by means of any Root aſſumed at Pleaſure, its Powers and their Reciprocals, diſpoſed in a regular deſcending Order, together with any Coefficients, as it may happen. And when theſe Series duly converge, they will as truly exhibit by their Aggregate the Quantity required, as a Decimal Fraction infinitely continued will approximate to its proper *Quæſitum*. This gives him Occaſion to expatiate largely upon the Nature and Conſtruction of Arithmetical Scales, particular and general; and to inquire into the Nature and Formation of Infinite Series, and their Circumſtances of Convergency and Divergency. To explain which he ſhews, that in every Series there is always a Supplement to be underſtood, when it is not exhibited. This Supplement ſums up the Series, and makes it ſtop at a finite Number of Terms, in Series that either converge or diverge. Whence in diverging Series it muſt neceſſarily be found and admitted, or otherwiſe the Concluſion will not be true; but in converging Series, where it can ſeldom be known, it may ſafely be omitted, becauſe it continually diminiſhes with the Terms of the Series, and finally becomes leſs than any aſſignable Quantity.

The Nature of infinite Series being thus diſplay'd, he applies them to the Reſolution of all kinds of Algebraical Equations. He explains in a very general Manner, the Author's famous Artifice, for finding the *Forms of the Series* for the Roots, and their initial Approximations, by means of a Parallelogram and Ruler, and ſhews its Application in all Caſes. Then he invents many ways of Analyſis, by which the Roots are further proſecuted, and may be produced to any Degree of Accuracy required. Alſo many other Speculations are added, to compleat the Doctrine of Series; particularly a very general and uſeful Theorem, for the Solution of all affected Equations in Numbers.

From the Reſolution of Equations and the Doctrine of Infinite Series, which finiſhes the firſt Part of this Work, Sir *Iſaac Newton* proceeds to lay down the Principles of his Method of Fluxions, which is the chief Deſign of the preſent Treatiſe. This Method he founds upon the abſtract or rational Mechanicks, by ſuppoſing all Mathematical Quantities to be generated, as it were, by local Motion, and therefore to have relative Velocities of Increaſe or Decreaſe, which Velocities he calls *Fluxions*. And the Quantities ſo generated by a continual Flux he calls *Flu-*

ents or flowing Quantities; the Relation of which Fluents is always expreſs'd by ſome Algebraical Equation, either given or required. If this Equation be given, and the Relation of the Fluxions is required, it conſtitutes the *direct Method of Fluxions*; but when the contrary, 'tis the *inverſe Method of Fluxions*.

Sir *Iſaac*, in his firſt Problem, which takes in the direct Method of Fluxions, ſhews how to find the Relation of the Fluxions in a very general Manner, and by a great Variety of Solutions. This way of reſolving the Problem is peculiar to this Work. He likewiſe extends it to Equations involving ſeveral Fluents, which accommodates it to thoſe Caſes, wherein any complex or irrational Quantities may be found, or Quantities that are geometrically irreductible. Then he demonſtrates the Principles of his Method, or the Precepts of Solution, from the Nature of Moments or vaniſhing Quantities, and from the obvious Properties of Equations, which involve indeterminate Quantities.

The Commentator much inlarges upon this whole Doctrine; he enters into the Reaſon and Uſe of this Multiplicity of Solutions, and ſhews it is a neceſſary Reſult from the different Forms the ſame given Equation may acquire. But eſpecially he takes the Author's Demonſtration into ſtrict Examination, endeavours farther to illuſtrate and enforce its Evidence, and to clear it from all the Objections that either have or may be urged againſt it. He even contends, that tho' the Moments and vaniſhing Quantities of the Author could be proved to be impoſſible, as has been ſuggeſted by ſome Mathematicians, yet even then they would be ſufficient for all the purpoſes of Fluxions, and he produces Inſtances of a like Nature from other parts of Mathematicks. And tho' the Author, Sir *Iſaac Newton*, in his preſent Treatiſe, does not directly mention ſecond Fluxions, or thoſe of higher Orders; yet the ingenious Commentator thinks proper to extend his Inquiries to theſe Orders of Fluxions, demonſtrates their Theory, gives Rules and Examples for deriving their Equations, proves their relative Nature, and even exhibits them to View by Geometrical Figures. This laſt he does chiefly in what he calls the Geometrical and Mechanical Elements of Fluxions; and he contrives a very general Method, by means of Curve-lines and their Tangents, to make Fluxions and Fluents the Objects of Senſe and ocular Inſpection; and thereby he illuſtrates and verifies the received Methods of deriving their Equations in all Caſes.

In the Author's ſecond Problem, or the Relation of the Fluxions being given to determine the Relation of the Fluents, which includes the inverſe Method of Fluxions, he begins with a particular Solution of it. He calls this Solution particular, becauſe it extends only to ſuch Caſes, wherein the given Fluxional Equation either has been, or might have been, derived from ſome previous finite Algebraical Equation. Then he ſhews how we may return directly to this Equation. But this is ſeldom the Caſe of ſuch Fluxional Equations, whoſe Fluents or Roots are propoſed to be found. For they have commonly Terms either redundant or deficient, by which they cannot be brought under this particular Solution. Therefore to anſwer this Caſe alſo, he gives us a general Solution, in which he extracts the Roots of any propoſed Fluxional Equation, by ſeveral ingenious Methods of Analyſis. And here it is chiefly, that he calls his Method of Infinite Series to his Aſſiſtance; for the Fluent, or Root, will here always be exhibited by a Series. And to find the Fluent in finite Terms, when it can be done, requires particular Expedients, as we ſhall ſee afterwards.

Mr. *Colſon* in his Comment upon this Part of the Work is very full and explicit. He explains and applies the Author's particular Solution; but is much more copious in explaining the Examples, and clearing up the Difficulties and Anomalies of the general Solution. This is chiefly perform'd by introducing ſeveral new and ſimple Methods of Analyſis, or Proceſſes of Reſolution; and by applying the Author's Artifice of the Ruler and Parallelogram mention'd before, to theſe Fluxional Equations: By which means not only the Forms of the Series are determin'd, and their initial Approximations, as has been obſerv'd above; but likewiſe all the Series may be found, that can be derived from the ſame Fluxional Equation. The Commentator concludes by giving us a very general Method for reſolving all Equations, whether Algebraical or Fluxional; which Method requires no foreign Aſſiſtance, or no ſubſidiary Operations, which all other Methods do. It is founded upon the Uſe and Admiſſion of the higher Orders of Fluxions, and is exemplify'd by the Solution of ſeveral uſeful Problems. Here the Comment leaves us, but we will go on with our Author.

Having thus taught us the Method of Fluxions, both direct and inverſe, he proceeds to apply this Method to ſome very curious and general Problems, chiefly in the Geometry of Curve-lines. As firſt, he determines the ***maxima*** and ***minima*** of Quantities in all Caſes, and propoſes ſome elegant Problems to illuſtrate this Doctrine. Then he teaches us to draw Tangents to Curves, whether Geometrical or Mechanical, and that after a great Variety of Ways, or however the Nature of the Curve may be defined. Here likewiſe he propoſes ſome Queſtions, to exerciſe and improve the Learner: Then is very particular upon finding the Quantity of Curvature, at any Point of a given Curve, whether Geometrical or Mechanical, or in determining the Centre and the Radius of Curvature: To which ſeveral other curious Speculations are ſubjoin'd of a like Nature. Here he communicates a very elegant and intirely new Problem, for determining the Quality of the Curvature, at any Point of a given Curve; or how the Curvature proceeds in reſpect of its greater or leſs Inequability.

Afterwards he goes on to the Quadrature of Curves, which chiefly gives occaſion to apply the inverſe Method of Fluxions. And firſt he ſhews how, by the direct Method, to find as many Curves as you pleaſe, (or to determine their Equations) the Areas of which ſhall be capable of an exact Quadrature. Then he ſhews how to find as many Curves as you pleaſe, which, tho' not capable of a juſt Quadrature, yet their Areas may be compared to thoſe of the Conic Sections, or of ſuch other Curves as ſhall be aſſign'd. Laſtly, He ſhews how to determine in general the Area of any Curve that ſhall be propoſed, chiefly by the Method of Infinite Series; where many curious and uſeful Speculations are occaſionally introduced and inſerted: As how to aſcertain the Limits of an

Area, when thus found analytically; how commodiouſly to ſquare the Circle, the Ellipſis, or Hyperbola, and how to apply the Quadrature of this laſt to the computing a Canon of Logarithms; the Conſtruction of Tables for the ready finding of Quadratures, or the Compariſon of Areas, and how to apply them to the ſolving of other like Problems; the forming of Conſtructions, and demonſtrating Theorems by Fluxions; the approximating to Areas mechanically, and ſuch-like.

From finding of Areas he proceeds to the *Rectification of Curves*; and firſt he ſhews how to find as many Curves as you pleaſe, whoſe Curve-lines are capable of an exact Rectification. Then he teaches us to find as many Curves as we pleaſe, whoſe Curve-lines, tho' not capable of a juſt Rectification, yet may be compared with the Lengths of any Curve-lines aſſign'd, or with the Areas of any Curve, when reduced to the Order of Lines. Laſtly, He determines the Lengths of any Curve in general, and gives ſeveral proper Examples of it. All which elegant Speculations are managed with admirable Skill, great Subtilty, and fine Contrivance.

VIII. *Of an* Inguinal Rupture, *with a* Pin *in the* Appendix Cœci, *incruſted with Stone; and ſome Obſervations on* Wounds *in the* Guts; *by* Claudius Amyand, *Eſq; Serjeant Surgeon to His* MAJESTY, *and F. R. S.*

OCtober 8, 1735. *Hanvil Anderſon*, a Boy, 11 Years of Age, was admitted into St. *George*'s *Hoſpital* near *Hyde-Park* Corner, for the Cure of a *Hernia Scrotalis*, which he had had from his Infancy, and a Fiſtula between the Scrotum and Thigh terminating into it, which for a Month laſt paſt had diſcharged a great Quantity of an unkindly ſort of Matter. The Rupture was ſmall, and not troubleſome, and Part of it could be replaced, but as it appeared that the Sinuous Ulcer ſprung from that Part that could not; ſo 'twas evident that the Cure of the Fiſtula depended upon the Cure of the Hernia, which latter could be obtained by no other Operation than that for the *Bubonocele*, which was agreed to, and performed the 6th Day of *December* following.

This Operation proved the moſt complicated and perplexing I ever met with, many unſuſpected Oddities and Events concurring to make it as intricate as it proved laborious and difficult.

This Tumour, principally compoſed of the Omentum, was about the Bigneſs of a ſmall Pippin: In it was found the Appendix Cœci perforated by a Pin incruſted with Stone towards the Head, the Point of which having perforated that Gut, gave way

to

to a Diſcharge of Fæces through the fiſtulous Opening therein, as the Portion of the Pin obturating the Aperture in it ſhifted its Situation. The Abſceſs formed in the Hernial Bag occaſionally, and the Suppuration for two Months laſt paſt from this Place outwardly, had knit and confounded, and, as it were, inbodied together the Gut and Omentum with the Hernial Bag, and theſe with the Spermatick Veſſels and the Teſticule, ſo that it was as difficult to diſtinguiſh them from each other, as it was to ſeparate them without wounding them; this Pin, whoſe Point was fixed in the Omentum, continually ſhifting its Situation, and occaſioning a Diſcharge of Fæces. The Pin frequently lying in the way of the Knife, and ſtarting out of the wounded Gut, as a Shot out of a Gun, the Inundation of Fæces upon this Occaſion from a Gut we could not well diſtinguiſh, were ſo many Difficulties in the way: But the greateſt yet was, what to do with the Gut, which all this while was unknown, and of which we could not come to the Knowledge, till the Operation was over; for this Appendix Cœci, which was the only Gut found in the Rupture, was ſo contracted, carnous, duplicated, and changed in its Figure and Subſtance, that it was impoſſible to determine what kind of Gut it was, or to find out that it was only this Appendix elongated, and in Diſguiſe.

We apprehended none of theſe Difficulties, when we undertook this Operation, in which we proceeded as uſual: The Omentum lying uppermoſt in the Hernial Bag was diſſected from the Parts it was knit to, and particularly the Gut it was imbodied with, and afterwards cut off cloſe to the Abdominal Muſcles without any previous Ligature, the Veſſels in it being ſmall, and the Subſtance of it more like a Sweet-bread than the Caul.

Much Time was ſpent in this Diſſection; we were ſtreightened for Room, and greatly diſturbed by the Diſcharge of the Fæces coming out of the Gut, upon every Motion the Pin lodged in it and the Omentum ſuffered, upon the Separation of theſe from each other. The Gut forming a double Tube, like a double-jointed Syphon, continuing in the Curve as it paſſed over the Teſticule and Spermaticks, was ſeparated one part from the other and from the adjacent Parts, as far as the Aperture in the Abdominal Muſcles, where the unperforated End of it was ſeparated therefrom, and thence ſtretched out and unfolded, which brought in View the Aperture made in it by the Pin hitherto concealed, through which that Part of it, which was incruſted with Chalk, had juſt made its way out upon an occaſional Preſſure, as a Cork out of a Bottle. It was the Opinion of the Phyſicians and Surgeons preſent, to amputate this Gut: To which End a circular Ligature was made about the ſound Part of it, two Inches above the Aperture, and this being cut off an Inch below the Ligature, was replaced in the Abdomen, in ſuch a Manner that an artificial Anus might be made there, if the Patient's Caſe ſhould require it. Afterwards ſo much of the Hernial Bag as had been detached from the Skin, the Spermaticks, *&c.* was cut off, which, as they appeared in a ſound State, were preſerved *in Situ*. The Fiſtulous Opening adjoining to the Thigh, and anſwering to the Aperture in the Gut, was opened; ſome Angles of Skin in the way removed; The Aperture in the Muſcles, which had

been

been inlarged by Inciſion, was ſtopped up with a Tent; and the reſt of the Dreſſings and the Situation of the Patient ordered ſo, as to remove from the Wound all ſuch Preſſure from within as might diſturb the Cure.

'Tis eaſy to conceive that this Operation was as painful to the Patient as laborious to me: It was a continued Diſſection, attended with Danger on Parts not well diſtinguiſhed: It laſted near half an Hour, and the Patient bore it with great Courage. During it the Patient vomited largely, and had ſeveral Stools, but was ſoon compoſed by half an Ounce of Diacodium, and Emollient Embrocations and Fomentations, frequently applied warm on the Belly: He was blooded, and an Emollient Carminative oily Clyſter was ordered to be applied in the Evening; but as he was eaſy, and the Belly not Tenſe, that was omitted. He was confined to a very ſparing Diet, and his Body kept open by Clyſters, injected every 2d Day, when Stools were wanted, to prevent ſtraining. When dreſſed upon the 4th Day after the Operation, every thing appeared well, and we had good Reaſon to hope for a Cure, eſpecially as the Diſcharge by the Anus was Natural. The Tent put into the Abdominal Aperture was not removed till the 8th. Upon the 10th the Ligature round the Appendix Cœci, where it had been amputated, dropt off, and no Fæces followed it; and as it was then plain they had taken the natural Courſe, from that Time the Wound was treated like an ordinary one, ſaving it was obſerved to keep a ſtrong and conſtant Preſſure over the Abdominal Aperture, as well to fence againſt the Intruſion of the Viſcera into the Wound, as by a ſtrong Incarnation and

Cicatrix, effectually to ſecure the Patient againſt a Rupture. During the Time of the Cure he was confined to his Bed, always kept to ſparing Diet, and ordered never to go to Stool but in a Bed-pan; by theſe means the Wound was completely healed up in leſs than a Month, and the Patient ſoon after diſcharged with a Truſs, which he was ordered to wear ſome Time, to confirm the Cure.

That the Appendix Cœci ſhould be the only Gut found in this Rupture, is a Caſe ſingular in Practice: This was full of Excrements, and occaſionally could be diſtended with an additional Quantity, which upon Preſſure was returned into the Colon, with that kind of Noiſe which Guts replaced generally give. This had occaſioned a Diminution of the Tumour when compreſſed, before the Operation was performed, as the Patient was lying backwards with his Head downwards, and an Increaſe of it as he ſtood erect, when the Fæces from the Colon could get into it again.

The Patient does not remember, when he ſwallowed the Pin which had perforated the Gut within the Rupture. But as this Rupture was from his Infancy, fixed and unreducible, ſo it is likely the Pin had then made its way into the Appendix Cœci prolapſed; and that an Inflammation enſuing thereon, had occaſioned an Adheſion, whereby the Increaſe of the Tumour had been checked, and the Reduction of the Parts prolapſed thereby, rendered impracticable.

The Surgeons who conſtantly dreſſed the Patient before the Operation, did obſerve then, as they have ſince, that the Humour diſcharged formerly at the Fiſtula, had frequently the Appearance, and, as they thought, the Smell of Excrements, ſo that there is no Doubt that the Cauſe of it was the Wound made in the Gut, by the Pin giving way occaſionally to ſuch a Diſcharge. The Patient alſo perfectly remembers, that the Impoſtumation or Gathering preceding the fiſtulous Diſcharge was attended with very little Pain, or much leſs than generally attends Suppuration. Which ſhews that the Extravaſation of the Excrements from the Gut into the Hernial Bag, and the burſting of this Bag, were the Cauſe of the fiſtulous Diſcharge, and of the continuance of it outwardly.

As to the Pin found in the Rupture at the Time of the Operation, it is obſervable, that two Thirds of it, incruſted with a chalky Matter, were confined and concealed within the Gut; the other Third next the Point, had made its way through it, the Point of which was ſo lodged in the Omentum wherein it was fixed, as to leave a free Paſſage for the Excrement from the perforated Gut outwardly, whenever the Perforation in the Gut, upon ſhifting the Poſition of the incloſed Pin, could open, and afford a Paſſage for the Diſcharge of the Fæces this way, which was as oft as this conical or pyramidal Pin did alter its Place, or did not exactly obturate the Aperture in the Appendix Cœci, it exactly fitted. I have already obſerved, that the Aperture made in the Gut by the Pin, lay concealed, the Point being lodged in the Omentum, lying parallel with the Gut, which was here duplicated, where it was ſo ſecured, that it ſeemed almoſt impoſſible it could ever make its way out of this Place, and its other Confinement in the Gut, as the Aperture was callous, and ſo reſiſting that it was with ſome Violence it was forced out of its Confinement through an Aperture fitted for the Point only and ſo ſtreight, that the Report upon its coming out was like that of a Cork out of a Bottle; for though it appeared the Opening had occaſionally been inlarged, as the incruſted Part of the Pin was preſſed forward into it, yet it is plain Nature's Attempts to get rid of it had been fruitleſs, and might poſſibly have been ſo during all the Patient's Life.

Sir *Hans Sloane* has furniſhed the Curious with Inſtances of Bodies incruſted in the Guts with Stone, and of ſome making their way out, when there was little Probability of it. Daily Experience ſhews how far Nature will ſtruggle to free herſelf, ſo that it is always moſt eligible to truſt them to her Care: This may appear from the Difficulties that have attended the Cure of this Caſe, which at laſt did not prove ſo ſucceſsful as it was firſt hoped for; for the Patient having been remiſs in the wearing of his Truſs, upon ſome Effort the Guts found a way into the Inguen again, ſix Months after the healing of the Wound. This Caſe alſo ſhews, that the beſt Operation, and the utmoſt Care, is no Security againſt the Relapſe of a Rupture. This is the 3d or 4th Inſtance I have met with, of the Inſufficiency of this Operation to effectuate a Cure of Ruptures; and yet it is plain, this is by far more likely to prove effectual, than the Cauſtick or any other Method cried up for the Cure of this Evil. In a growing Age, a good Spring Truſs is an effectual Remedy; and in an Adult, this ſhould be the ultimate one, though it is no more than a Palliative Cure.

N. B. The Omentum and the Gut amputated, with the Pin perforating it, are in the Repoſitory of the Royal Society.

This Obſervation puts me in Mind of two I made during the late War in *Flanders*, and of two more lately in *London*.

OBSERVATION *I.*

Upon opening the Body of a Soldier who had laboured many Years with an Inguinal and Scrotal Rupture, I found in a Segment of the Ilion, an Appendix like a Cœcum, about ſix Inches long, ariſing from that Gut, and nearly of the ſame Diameter with the Gut itſelf, the Coats whereof were ſomewhat thinner than thoſe of the Ilion this Cœcum did ariſe from, whoſe Membranes and Dimenſions were Natural. This Elongation of a Segment of the Ilion appeared as if it had been lodged in the Rupture Bag it lay near to, and into which it had been ſtretched along the Vagina of the Spermatick Veſſels down to the Teſticule, according to the Expanſion of the Rupture Bag, which was of the ſame Dimenſion: This Production of the Ilion, or *Appendix Ilii*, was full of Fæces, ſomewhat narrower at its Riſe or Opening into the Ilion than elſewhere, but nearly reſembling it, and as ſound as that Gut it ſprung from.

OBSERVATION II.

A Soldier having been ſhot through the Belly, the Ball was cut out upon the poſterior part of the Os

Iliûm. Through both Wounds the Fæces were chiefly diſcharged for ſeveral Months after, and at Dreſſings a great Number of flat Worms, dead or alive, were found upon the Plaiſter. The Fæces having by degrees taken their Courſe through the Anus, in five or ſix Months after, the two Wounds being healed up, the Patient returned to his Duty as a Soldier, and ſoon after was made Corporal, and then Serjeant.

Eight Years after this, I had him again under my Care at the Hoſpital, where he was brought with the Head of the *Os Humeri*, together with that of the *Acromion* and Clavicule, in the Articulation with the *Scapula*, fractured by a Cannon-ſhot, which thereby was laid all open. The Limb was immediately cut off in the Articulation with the *Scapula*, having firſt premiſed a Ligature about the Fleſh ſurrounding the Veſſels, by thruſting cloſe to the Bone a Pack-Needle armed with a ſtrong Packthread, there being no room for the *Tourniquet* *: He loſt very little more Blood in the Operation, than if a *Tourniquet* had been applied; but the great Diſcharge of Matter ſunk him, and he died the 8th Day after.

The Death of this Patient gave me an Opportunity of examining how the former Wound in the Gut had been cured. I had thought the Wound had been in the Iliûm, from the Thinneſs of the Fæces diſcharged through that Wound; but, upon Diſſection, I found it had been in the Colon in the broadeſt Part of it. This was very much contracted, and made narrow in that Part of it that had been ſhot through, where it appeared purſed up, and inſeparably knit to the Ilium Bone. However, the Patient never had complained of any Inconveniency therefrom, though the Narrowneſs of the Gut in this Place was ſuch, as ſeemed to make the Deſcent of the Fæces difficult.

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* Mr. *Le Dran*, in his Chirurgical Obſervations, Vol. II. Obſerv. 43. 12°. 1731. has deſcribed the Manner of performing the Amputation of the Humerus in the Articulation with the Scapula, to which the Reader is referred.

OBSERVATION III.

On the 19th of *January* 1729, I attended Miſs—— aged 14, on account of a ſuppurated Tumour on the Navel, whoſe Situation was under the *Muſculi Recti*. This Patient had had, what is truely called, a Starting at the Navel in her Infancy; and of late had complained, at Times, of a Swelling there, and *alſo* of Colicks, Gripes, or Vomitings, that uſed to go off, particularly as that Swelling diſappeared. As theſe grew more troubleſome, ſhe lately had taken a Vomit, from which Time ſhe had been greatly cauſtive, and her Reachings, Vomitings, and Colicks, had proved more conſtant, together with an increaſing Tenſion and Pain in the Fore-part of the Belly, and a Tenderneſs at the Navel, as Matter was gathering there.

Some Days before I was called in, Dr. *Campbell* had employed the propereſt Remedies to remove theſe Complaints. Upon a Conſultation, we agreed to diſcharge by Inciſion the Matter collected at the Navel, being about a Spoonful of undigeſted Fluid, that had made its way through the *Aponeuroſis* of the Abdominal Muſcles adjoining to the Navel Cicatrix: Notwithſtanding which, the Tenſion of the Belly, the Caustiveneſs, the Reachings, and Vomitings, rather increaſing, as in the *Miſerere Mei*, and having thence a Reaſon to apprehend a Strangulation and Suppuration of ſome of the *Viſcera* in the Neighbourhood of the Navel, Dr. *Hollings* being called in, it was agreed to inlarge the Aperture made by the fore-mentioned Matter in the *Linea Alba*, with a View and Intent to know the State the Parts were in, to reduce what we found there, or at leaſt to procure a more free Diſcharge to the Matter collected under the *Aponeuroſis* of the Muſcles: For a Fortnight and more, every Thing was done that could internally or externally eaſe the Diſcharge, and open the Paſſage for the Fæces downwards, but all in vain. The Patient was a whole Fortnight without a Stool, all the Symptoms daily increaſing, though towards the latter End ſhe vomited rather more ſeldom: Yet, as ſhe was ſtill taking in, ſo the Dimenſions of her Belly increaſed in Proportion, and the more for that the Air confined and rarefied in the Fæces pent in, added daily to the Tenſion; which at laſt had ſtretched the Skin to the utmoſt. There was alſo a Suppreſſion of Urine, the Fundus of the Bladder being ſtretched towards the Navel, at the ſame Time that the Neck of it was compreſſed by the Fæces bearing down in the Pelvis, and a Tumour ſprung up about the Anus, as if they had been ſeeking a Paſſage that way. It was propoſed to ſcoop them out, but the Rectum was found empty, and the Obſtruction as far beyond the Reach of any Chirurgical Operation, as it had proved againſt all the Means hitherto employed.

The Patient was now reduced to the loweſt Ebb. The Dejections were Excrementitious, her Pulſe de-preſſed, and extremely weak; ſhe had Rigors, clammy Sweats, and all the Symptoms that denote an approaching Death, from a Mortification in the Guts, when of a ſudden the Fæces burſted the Gut, and forcing their way through the Inciſion at the Navel, a Quantity equal to two or three Quarts, intermixed with various kinds of Fruits and Seeds, which ſhe had been taking during her Illneſs, flowed out like a Torrent, with a ſurprizing roaring Noiſe, which gave her immediate Relief. The Diſcharge continued very great all that Day, but the Aperture in the Hernial Bag was not anſwerable to that in the Gut, ſo that the Diſcharge there was at Times checked by Subſtances obturating it; this Aperture therefore was inlarged by Inciſion, and thereby the Patient releaſed from the Violence of the Vomiting and Hickup. From this Time we began to entertain ſome Hopes of a Cure; for though the Patient was extremely reduced, and the Diſcharge continued exceedingly great during ſeveral Days, with a Singultus and Vomitings; yet ſhe was refreſhed with Sleep, and was able to retain ſome Nouriſhment. The Tenſion of the Belly ſubſiſted, though in a leſſer degree, until the Fæces had made their way downwards, and ſo did the Vomitings at Times, ſo long as the Inflammation continued. The Diet was ſuch as the Caſe required; Clyſters were frequently applied, as well as Fomentations, and every Thing elſe that could determine or invite the Diſcharge through the Anus, and reſtore the diſtended Guts to their Tone; but from the Time the Fæces burſted the Gut, it was 12 Days before any took the natural Courſe; and then we were again brought to the Brink of Ruin, for they then poured down ſo faſt for a Day or two, that the Patient was like to have ſunk under them: However, this ſevere Evacuation was timely conquered by Abſorbents and Diluents: It took off the remaining Tenſion of the Belly, and all Vomitings; and as from this Time the Fæces had a free Diſcharge the natural way, and the Diſcharge through the Wound decreaſed in proportion, ſo the Wound in the Gut, and the external Wound in the Integuments were healed up in about three Weeks, in ſuch Manner that the Patient has ever ſince enjoyed a moſt perfect Health.

Observation IV.

It happened that I was not a meer Stranger to the principal Circumſtances of this Caſe, as in the Year 1716 I had attended ſuch another with the late Mr. *Laſage*, Surgeon, *viz.* Miſs——a Girl about four Years of Age, in whom the ſame Cauſe had produced the like Effects; for upon a Suppuration of the Omentum ſtrangulated in the Navel of this Patient, the Fæces detained in the neighbouring Gut had in like Manner forced their way through the Navel: The Accident previous to the burſting, and ſubſequent upon it, having been nearly the ſame as in the former Obſervation; only the Cure proved ſomewhat more tedious, for the Wound was kept open by Currants-ſeeds frequently working their way out at the Navel for about 12 Months after; when it was made complete: ſo that the Hardſhips the Patient has undergone ſince in Child-bearing, and ſeveral hazardous Labours, have not been able to diſturb it.

Hence it appears, that the Parts inflamed and in Contact have been coaleſced and knit together, ſo as to prevent any Extravaſation from the wounded or burſted Gut into the Cavity of the Abdomen.

That the Cure in the two laſt Caſes has been owing to a free Diſcharge of the Fæces through the Wound, and conſequently that when in a Gut-Rupture the Part prolapſed cannot be reduced, a Cure may be hoped for by making ſuch an Opening in the Guts, before they are intirely ſphacelated, as may procure a free Diſcharge to the Fæces pent in, and thereby ſecure the Patient's Life.

That if this happens to the Colon or Cæcum, the Tube of it will ſo far be preſerved as to open a free Diſcharge for the Fæces the natural way; and if that cannot be obtained in a Wound of the ſmall Gut, yet the Diſcharge may be ſecured by making the Wound an artificial Anus.

That the readieſt way to obtain a Cure of a wounded or burſted Gut, is to keep it in Contact with the outward Wound, and the Patient in a very low Diet.

That the Deligation of the Veſſels of the Omentum previous to the Amputation of it, being liable to many Exceptions, it is more eligible to forbear it, ſaving when the Veſſels are large; for when reduced looſe and floating, it is leſs liable to the Inflammations and Suppurations that attend the Separation of the Ligature.

IX. HERMANNI BOERHAAVE, *A. L. M. Philoſoph. & Med. Doct.* Medicinæ *in Univerſitate* Leidenſi *Profeſſ. Colleg. Chirurgic. Præſ.* Reg. Soc. Lond. *necnon* Reg. Scient. Acad. Pariſienſ. Soc. *de* MERCURIO Experimenta.

PARS II. *

OBſervationes de Mercurio quaſdam anno præterito conſcripſi, quibus conſtitit argentum vivum, quamvis continuo ſe in alia corpora mutare videatur, propriam, per quam immutabile eſt, facultatem miro modo retinere. Haſce Literatæ, quæ in Anglia ſub Britannici Regis floret auſpiciis, Societati obtuli Obſervationes; et ultra ſpem meam dignæ judicatæ ſunt, quæ inter Acta illuſtriſſimi Sodalitii publicarentur. Unicum in iſto Scripto mihi fuit propoſitum, operationes à me de Mercurio inſtitutas, et quæ ex iiſdem producebantur, fidè & accuratè narrare; quo Lectores à labore & ſumptu ad eaſdem repetendas neceſſariis liberarem. Idem jam quoque mihi eſt Conſilium, ut Academiæ maximis Regis Chriſtianiſſimi beneficiis ornatæ experimenta, quæ de eadem re perfeci, offerrem. Ambas Diſſertationes conferendo, de fide & accurata antiquorum verorumque

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* Vide Part. I. Philoſ. Tranſact. N° 430. p. 145, & ſeq. Partem hanc II. in Act. R. Scient. Acad. Pariſ. 1734. Gallicè editam, latinè vertit *C. M.* R. S. Secr.

Alchemiſtarum ſubtilitate in his, quæ de Mercurio dixerint, judicium facere poterimus, videbimuſque ſimul diligentiam magnam prudentiamque neceſſarias eſſe ad ſenſa eorum explicanda, vel ad cenſuram de iis juſtè ferendam. Spero etiam Chemiæ ſtudioſos cautos reddere, ne facilè decipiantur per doctrinam iſtam vagam Alchemiſtarum hodiernorum, qui nihil boni vel ſolidi rectè ſapiunt, & qui artem non poſſident aliam, quàm qua aurum ipſiſſimum per fallacias ſuas extorqueant ab iis, quos adducunt ut credant ſe poſſe veram auri conficiendi methodum ipſos docere. Quod de argenti vivi immutabilitate, ſimplicitate & proprietatibus ſingularibus antea demonſtravi; denique confirmaturus ſum. Docto, uti eſt, Veſtro, Sodales, cætui convenit dijudicare de uſu & veritate hujus ſcripti; cui examinando ut momenta aliquot otioſa impendatis, et negotia pauliſper remittatis, vos rogo. Scio equidem vobis rarò vacare; et brevis eſſe, quantum potero, conabor. Rem aggredior.

I.

Argentum vivum purum, quale venale plerumque reperitur penes Mercatores Societatis Amſtelædamenſis, diu digeſtum ſuper ignem, non mutatur in metallum.

OPERATIO.

Hydrargyrus hicce diſtillatus nullam reliquit fæcem. Deinde admiſtus aceto diſtillato, & ſali marino, & per diutinum tempus agitatus, purus remanſit. Premebam per Alutam; libramque ejuſdem altæ mundæ infundebam phialæ, cujus os obturabam cono chartaceo, alia charta ad collum phialæ bene ligata iterum cooperto, quo
nullus

nullus pulvis intrare poſſet, Aër verò liberè ingrederetur vel exiret: imponebam Furno ad calorem continuum, qui ad Thermometrum D. Fahrenheyt ſupra gradum centeſimum à 15 Novembris 1718. uſque ad 23 Maii 1734. fovebatur. Reperiebam tunc Mercurium hunc in hac phiala fluidum cum pauxillulo pulveris nigri in ſuperficie; pulvis hicce in mortario tritus in mercurium reviviſcebat. Totum hocce Argentum vivum immittebam in Retorta vitrea munda diſtillandum, augendo ignem verſus finem, donec Retorta ferè candida fieret. Nihil omninò remanſit in Retorta, Mercurius enim exiverat ſine ulla ſenſibili mutatione.

COROLLARIA.

1. Ignis ad gradum & per tempus ſupradicta nihil mutat de fluiditate, volatilitate, nec de natura Hydrargyri in vas, ubi aër liberè accedit, immiſſi: neque ulla facta eſt ſeparatio puri ab impuro.

2. Nec facta eſt ulla metalli minima quantitate ſenſibilis Generatio.

3. Multò minus Argenti vel Auri.

4. Nihil de Mercurio per hanc operationem fixatum eſt Annos 15 & ½ continuatam; nec minimum apparuit initium fixationis metallicæ, ne plumbi quidem; quod tamen, ut aiunt qui ſe hoc optime ſcire gloriantur, metallum debet ab hac operatione primum formari.

5. Operatio hæcce nullatenus favet opinioni affirmantium, quòd ex Argento vivo uti materia, & ex igne uti ſulphure figente, per digeſtionem unitis, formentur metalla.

6. Videtur omninò probabile omnes ſimiles cum argento vivo ſincero vulgari inſtitutas Operationes nullatenus his, quæ deiis pollicentur Auctores, reſpondere, cum pauxillum iſtud pulveris nigri, de quo locutus ſum, ſit levius Mercurio, cujus ſuperficiei ſupernatat, & facillimè iterum in Mercurium redeat: videte, quæ de ſimili pulvere nigro è Mercurio per motum ſolum educto in Act. Philoſophic. Regalis Societatis Londinenſis, N° 430. dixi.

7. Non conſtat vivum in fodinis Argentum poſſe in rem quamcunque Metallicam mutari per actionem ſolam caloris ſubterranei per diutinum tempus agentis, & in loco, quô Aër libere accedit. Nam, Calor in locis, ubi venæ metallicæ reperiuntur, rarò ſuperat gradum 70^{m}. Inquiunt quidem opus eſſe mille Annis ad hunc effectum producendum; quomodo autem homines, ævi adeo brevis, hoc certò ſcire potuiſſent?

8. Quoad Sulphur, quod unum eſſe de principiis metallorum crediderunt Alchemiſtæ, & de quo dicunt, quòd argenti vivi elementa conſociet, quò corpus ſolidum fiat fixumque ad ignis gradum, qui illud fundat, & malleabile reddat; hocce, inquam, ſulphur videtur omnino differre à materia iſta luminis ſeu ignis, quamvis ignis ſolus ſit unicum miram hanc inter ſulphur & Mercurium unionem producendi inſtrumentum.

Nihilominus in hac operatione liberè ad Mercurium admittebatur Aër, & diceretur forſan, hoc ipſum eſſe, quod ignis actionem impediat, eò magis quòd aſſerant Alchemiſtæ, aëra crudum impedire coctionem ſophicam; hoc me ad ſequens experimentum, quod recitaturus ſum, faciendum induxit.

II. Ar-

II.

Argentum vivum per tempus infra memoratum, digeſtioni in vaſis probè occluſis commiſſum, non producit ullum Metallum.

OPERATIO.

Hydrargyrum purum vaſi immittebam vitreo conico fundi plani, quali ad argenti & auri ſeparationem utuntur Docimaſtæ, eumque exponebam calori 100 graduum à 6 Decembris 1732. uſque ad 8 Julii 1733. Vaſe ſemper obturato, Mercurius nullam notabilem paſſus eſt mutationem; accipiebam hujus uncias 6, quas vaſi præcedentis ſimili indebam, inque os ejus inſerebam collum phialæ ſubverſæ; vaſis non ſimul lutatis, cum per 4 dies igni arenæ adeo fervido, ut aſcendere inciperet Mercurius, exponebam, quò ſcilicet expellerem totam, quam continere potuit, humiditatem. Cum ne vel minimum ſupereſſe mihi videretur humiditatis ſignum, lutabam exactè locum, ubi ambo vaſa coaptabantur. Mercurium exponebam igni arenæ violento ſatis, qui cum leniter aſcendere deſcendereque cogeret; hunc caloris gradum uſque ad 29 Januarii 1734 continuabam: in fundo vaſis nil inveniebam præter Mercurium fluidum pulvere nigro levi & ſubtili modicè coopertum, nihil fixi, nihil præcipitati, licet aquæ ebullienti proximior eſſet caloris gradus. Deinde huncce Mercurium transfundebam per mundum ſicciſſimum chartaceum infundibulum, cujùs orificium inferius ægerrime crinem tranſmitteret. Mercurius ſinceriſſimus tranſiit per foramen iſtud parvulum; & in parietibus & circum foramen infundibuli manſit pauxillum nigri, quod, in Mortario tritum, in Mercurium rediit. Mercurium illum ſic depuratum in Retorta vitrea munda diſtillandum imponebam igni arenæ, & juxta finem igni ſuppreſſionis; nihil omninò fixi in fundo Retortæ remanſit; aliquantulo fluidius quàm antea apparuit Argentum vivum, ſed aliàs nullo modo mutatum.

COROLLARIUM.

Hinc eadem, quæ de præcedenti experimento, concludenda ſunt; & ſi illis, quæ de eadem re in Tranſact. Nº. 430. ſcripſi, conjungantur, apparebit clarè Argentum vivum naturâ ſuâ per motus mechanicos, per Diſtillationes Digeſtioneſque deſcriptas immutabilè eſſe. Ex hiſce omnibus infero, quòd Chemiſtæ abſtinere poſſint ab inutili harum operationum repetendarum labore, quo Mercurium fixare, vel *in corpus* aliud quodlibet mutare nituntur; iiſque inſuper conſulo, ut diffidant ignaris, multa hujuſmodi inepta pollicitantibus, inter quos minus peccant, qui alienis impenſis experimenta periclitari conantur.

Experimentorum aliorum, quæ de metallis inſtitui, haud minus quàm præcedentia, laborioſorum ſequelam declaraturus ſum. Diu laboravi, ut certo ſciam, an verum ſit poſſe metalla per artem reſolvi in Argentum vivum, & in aliud principium; plurimi Auctores adeo diſtincte & tot in locis hoc affirmant, ut de re ipſa dubitandi nulla mihi videretur cauſa: Rem credebam fidei iſtorum Auctorum; ſed ut oculis propriis convincerer, tentamentum plumbi feci. Clariſſimus *Joh. Baptiſta van Helmont* (poteſt. Medicam. §. 40.) ait; " Senſi, inquam, cruditatem Saturni, pin-

“ guedine fixorum ſalium ſolubilem, ſolo quandoque “ igne carptim delebilem, ſicque dividi compoſiti “ partes, crudumque Argentum vivum currere per“ mitti.” Filius ejus *Franciſcus Mercurius van Helmont* dicit, “ Quando plumbum ſolvitur ab Alcalibus “ & Salibus, vel Oleis, quæ Sulphur ad ſe trahunt, “ & id à corpore ſeparant, plumbum hiſce modis “ mutatur in Mercurium volatilem, fluidum, qui “ ignem haud amplius pati poteſt uti antea, ſed fri“ gidus eſt & fluidus inſtar aquæ, exuta forma metallica. “ (*Vide*, The Paradoxical Diſcourſes of *F. M. van Hel*“ *mont*, *London*, 1685. in 8vo. Part II. §. 22. p. 111.” *) *Joachimus Becherus* idem affirmat, ſpondetque ſucceſſum plurimis, quæ ad hanc rem deſcribit, experimentis (vide *Collectanea Quingentorum Experimentorum*, à p. 310. ad 333). Ecce clarè & breviter quæ de hac re, adhibito tædioſo maximè & diuturniſſimo Labore, didici.

OPERATIO.

Solvebam tantum Ceruſſæ puræ, quantum diſſolvi potuit, in ſpiritu nitri ab aqua ſextupli ponderis diluto; filtrabam hanc ſolutionem, quæ clara admodum inventa eſt. Ex hoc liquore vaſi mundo vitreo indito, ad calorem lenem inſpiſſato, deinde in loco frigido ad quietem repoſito, formatæ ſunt Cryſtalli, quarum ſumebam uncias quatuordecim, quas in mortario vitreo cum piſtillo vitreo in pulverem redigebam. Huncce pulverem in Aqua pluviali puriſſima ſolvebam, ſolutionemque diluebam triplici Aquæ pluvialis quantitate; deinde Solutionem aliam filtratam & clariſſimam ex Sale Ammoniaco in Aqua pluviali factam lentè & cautè affundebam: Miſtura fit inſtar Lactis candida, & plumbum ſtatim præcipitatur, uti accidit Argento in Aqua Forti ſoluto, ſimul ac admiſceatur Sal Ammoniacus. Pulvis in fundo præcipitatus, qui albus fuit Nivis inſtar, plurima aqua lotus, deinde ſiccatus, valde inſipidus extitit, unciaſque 18 cum $\frac{1}{2}$ pependit. Uncias 6 pulveris hujus albi ſiccique Urinali vitreo mundiſſimo indebam, infundebamque ad altitudinem duorum digitorum ſupra hunc pulverem lixivium fortiſſimum è calce vivâ cineribuſque clavellatis confectum, quod in phialâ benè clauſâ plures Annos conſervaveram: deinde urinale chartâ *bibulâ circa* ipſius collum bene ligatâ tegebam, ponebamque in furno putrefactionis ad calorem graduum 96. & ibi relinquebam à 6to. Februarii 1732. uſque ad 13m. Auguſti ejuſdem Anni tentaturus, an hæc miſtura Aëri expoſita putrefactionis calore mutaretur; nihil inveniebam præter maſſam albam, quæ ſalem ſapuit redacta in pulverem; quem Retortæ vitreæ luto ex Argilla Arenaque compoſito loricatæ indebam: hanc urgebam igne nudo, donec candeſceret, eundemque calorem tres horas continuabam: Aſcendit in Retortæ collum albæ fuliginis pauxillum, nihil autem omninò Mercurii, & in fundo remanſit Materies fragilis ſemivitrificata colore cinereo; hanc redigebam iterum in pulverem ejuſdem coloris, quem in Mortario cum Salis alcalini fixi calciſque vivæ lixivio diu conterebam, ſiccabamque iterum igni lento; novum Alcali affundebam, calorique 96 gradiuum à 18$^{mo.}$ Auguſti 1732. uſque ad 15 Octobris 1733. exponebam, terendo quotidie in mortario vitreo, in quo continebatur, quod charta ſolummodo tectum Aerea liberum admittebat. Erat tunc albus ſiccus & acer pulvis; qui poſt idem Lixivium denuo affuſum, tritus in paſtam redigebatur; putrefactioni objiciebam, uti ſuprà, ſæpius terendo, à die ſupra memorato uſque ad 21$^{m.}$ Februarii 1734. Tunc erat maſſa ſalina, alba, marinique ſalis ſapori proximior. Poſtquam trita eſſet, & Aquâ probè lota lentiſſimeque ſiccata, pulverem inveni album inſipidiſſimum; Retortæ immittebam, quam retinebam per plures horas in igne maximo, quem pati potuit vitrum lutatum: 20$^{mo.}$ Maii 1734. nullus exivit Mercurius; collum retortæ tinctum eſt diverſis coloribus; maſſa, quæ in fundo manſit friabilis, exhibuit etiam colores diverſos laminatim diſpoſitos, & uncias 5 cum drachmis 6 & $\frac{1}{2}$ pependit; pulvis, in quem fuit redacta, tritus ruforum cinerum colorem præbuit.

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* When Lead is diſſolved by Alkalies, and Salts or Oil, which take in the Sulphur, and ſeparate it from the Body, the Lead by this Means becomes changed into a volatile running Mercury, which can no more endure the Fire, as before, but is cold and running like Water, and without a metalline Form.

SCHOLIUM.

Plumbum erat primò in hac operatione Ceruſſa, penetratum nempe & vapore aceti ſolutum, in calcem albam & dein in pulverem ſubtilem redactum. Solutum erat in Spiritu nitri diluto, ſicque factum eſt plumbum Liquor clariſſimus abſque colore, guſtu dulci, in quo redactum diviſumque eſt in partes minutiſſimas. Tertiò Sal Ammoniacus ſolutus, qui affundebatur, expellendo Spiritum Nitri, in ejus locum ſubſtituit Spiritum Salis marini, & ſe intime uniendo parti plumbi metallicæ diſpoſuit eam, quantum poſſibile, ad ſeparationem Mercurii à parte metallicâ expediendam, ſecundum eorum, quos optime ſcripſiſſe de his rebus credimus, opinionem; ſeparandi enim Mercurii à Metallis proprietatem ſali Ammoniaco imprimis & marino attribuunt. Quartò, Calcem ſic præparatam, & cum Alcali violentiſſimo per ſeptem menſes in digeſtione retentam debere Mercurium manifeſtum reddere viſum eſt, abſorbendo Sulphur Saturninum: Nihilominus, quamvis ignis admotus fuerit magnus, ne minimum quidem dedit Mercurii. Quintò, Maſſa hæc diu & fortiter trita, dein admiſta novo fortiſſimoque Alcali, & per quatuordecem menſes digeſta, haud præbuit ullum Mercurii veſtigium. Sextò, Trita erat denuò cum novo Alcali, & per quinque menſes digeſta, adeo ut poſt omnes haſce Operationes, expoſita fuerit ſatis Alcalici Salis actioni, ut tempus habuerit ſeparandi partem plumbi ſulphuream, & ut Mercurius hoc ſulphure liberatus è maſſâ hac per ignis vim exprimi potuerit. *Nihilominus*, poſt omnem hunc laborem, nullum Mercurium eduxit ignis maximus.

Liquet igitur, quod de facilitate extrahendi Mercurium è plumbo audacter pronunciaverint Auctores, experientiâ haud confirmari. Plumbum nempe, aiunt Auctores iſti, metallum eſt plurimum Mercurii continens, quod per ſales reſuſcitantes ſe in Mercurium facillimè reſolvit. Res igitur difficilior eſt in aliis Metallis. Pollicentur tamen Auctores hoc ſatis facilè fieri poſſe, methodoſque præſcribunt parum diverſas ab hac, quam jam declaravi, & quæ poſt tot labores me docuit, nullatenus mihi proſperè ſucceſſiſſe, quod promiſerant. An iſtorum Auctorum de hac re aſſertiones Obſervationibus ſatis nitantur, admodum dubito. Adducor potius ut credam, eos de hac re opinioni propriæ magis ceſſiſſe, quam experientiam conſuluiſſe.

ſuluiſſe. Quidquid jam declaravi, ad Lectorem à labore & ſumptibus harum obſervationum repetendarum liberandum ad mininum inſerviet, eumque impediet, ne ſimulata ſcientiæ metallicæ principia facilè admittat. Optandum eſſet quammaximè Chemiſtas hoſce ingenioſos & laborioſos ſucceſſum experimentorum, quæ ſpem eorum fruſtraverant, fidè nobis dediſſe, & operationes, priuſquam eas ipſi inſtituiſſent, nunquam nobis præſcripſiſſe: quod noſtro peperciſſet tempori, ſumptui, & labori, & inter Scientias ſuam Chemia ſedem brevi obtinuiſſet: alioquin, niſi valde fallor, ad veritatem, quæ unica Inquiſitionum noſtrarum eſt meta, nunquam pervenietur.

III.

Iſaacus Hollandus ſcripſit, Argentum vivum poſſe è Sale plumbi per acetum diſtillatum confecto facilè extrahi: cupiens tentamen ex optimo Lithargyro & aceto vini diſtillato inſtituere, ſuccum concretum, qui ſuccus Saturni appellatur, parabam; uncias 2 calcinabam in vaſe vitreo aperto ad ignem lenem à 6$^{to.}$ Junii 1734. uſque ad 19$^{m.}$ Julii proximi continuatum. Albus, qui exinde provenit, pulvis vitreo piſtillo ſubtiliſſimè in mortario vitreo tritus erat. Triturabatur velociſſimè & diu, ſubinde affundendo lixivium Sale fixo Alcalico violentiſſimo, quantum Aqua diſſolvere potuerit, ſaturatum. In eodem mortario chartâ tecto, ad calorem à 21$^{mo.}$ Julii uſque ad 27 Novembris continuatum, retinebam. Hic quamprimùm ſiccatus eſt pulvis, ut per totum illud tempus trituraretur, curabam novo affuſo lixivio. Siccando, humectando, & triturando alternatim per totum illud tempus, ad calorem 90 graduum retinebam charta tectum. Ultimo die materiam hanc ſiccam & albam in pulverem non palpandum contundebam; quem retortæ vitreæ lutatæ immiſſum, igni per gradus cautè aucto, donec can-

deſceret

deſceret Retorta, per 4 horas exponebam. Haud apparuit vel minimus Mercurii globulus, nec in Excipulo, neque in collo Retortæ, in cujus fundo reperta eſt Maſſa aterrima, levis, ſpecie pulveris, guſtu acerrimi Alcali. Die Novembris 28º· ſupra ſcutellam vitream in cella reponebam, ubi ſtatim madeſcebat; ibique uſque ad 8ᵐ· Januarii 1735. relinquebam. Tunc vero erat hujus materiæ volumen auctum, totâ parte ſalinâ per Aëris humidi opem in liquorem ſpontè mutatâ, parteque metallicâ in fundo ſub forma pulveris nigri manente. Totum ſimul ſiccabatur, tam id, quod liquefactum fuit, quàm id, quod non fuit in liquorem mutatum; & miſtura hæc reperta eſt aterrima. Retortæ iterum immittebam vitreæ, & finem verſus igne urgebam, qui totum per 4 horas candefecit. Nec hac vice pluſquam alterâ apparuit vel minima Mercurii nota, nec in Excipulo nec in Retorta, in *cujus* fundo manſit Materies colore cinericio, ſapore ardenti ignis inſtar, quæ Aëri expoſita ſtatim in Liquorem verſa eſt.

In hac operatione plumbum aceto puro ſolutum & relaxatum, & tali modo diſpoſitum, ut à ſale intimè penetrari poſſet; miſtum & trituratum cum Alcali fixo, cauſtico, liquido; digeſtioni expoſitum, putrefactioni objectum; igni violento admotum; humiditate Aëris per menſem Philoſophicum diſſolutum; denuo tritum, ſiccatum, vehemente igne adactum, hihil omninò Mercurii præbuit.

Quidnam igitur cogitandum eſt de hac re, & de hoc, quod circa eam adeo audacter pronuntiant homines creduli, ignavi, vel ſoli ſpeculationi dediti? Operibus inutilibus, ſumptibuſque immodicis implicant illos, qui diligentiæ in labore plus, quàm Scientiæ poſſident, unde exoſam reddunt artium pulcherrimam.

Proficiant alii laboribus & ſumptibus meis, & utantur, ut propriis parcant.

IV.

Poſtquam ex propriâ experientiâ certus eſſem, quòd ex plumbo Mercurium extrahere Sales reſuſcitantes appellati modo deſcripto non poſſent; Quid ipſum argentum vivum producere hoc in caſu potuerit, tentare volui; præſertim cum Chemiſtæ hoc fluidum vocent Aquam metallorum, in qua, aiunt, illa moriuntur, renaſcuntur, & pulchriora, quàm antea fuerant, evadunt. Fundebam igitur in cochleari ferreo mundo unciam plumbi; calefaciebam eodem tempore in cochleari ſimili uncias tres argenti vivi puri. Affundebam deinde Mercurium calefactum plumbo liquefacto; commixta ſunt illico ſimul, & maſſam conſtituerunt ſolidam coloris Argentei. Conterebam, & poſtquam eam mollem iterum reddidiſſem, phialæ inditam parvæ calefaciebam, & obturata dein ſubere phiala, ponebam in furno digeſtionis ad calorem ſemper æquabilem 84 gradium ab 11 Februarii 1732. uſque ad 10 Januarii 1735: Amalgama fuit molle, piſtillo butyri inſtar cedens, nigreſcens illicò, cum agitaretur, uncias quatuor pendens. Eodem die in retorta vitrea munda igni arenæ exponebam, & tandem igni ſuppreſſionis adeo vehementi, ut per 4 horas arena tota candeſieret, tranſiverunt in Excipulum Mercurii unciæ duæ cum 6 Drachmis & ſemiſſi. Ruber, quem in Retortæ fundo et collo inter diſtillandum Mercurius formavit, pulvis, et quicquid vivi argenti pauxillum collo adæſit, quique nonnulli plumbi omninò puri globuli pulveris ſpecie adfuerunt, grana 52 unà pependerunt. Denique in fundo fuit ſolida plumbi Maſſa unam, granis 5 deductis, unciam pendens, quæ pondus ſupplebant Globulorum iſtorum parvulorum plumbi ſub pulveris ſpecie jamjam memoratorum;

unde

unde compertum eſt, quòd plumbum totum remanſerit, & quòd grana Mercurii 43 diſſipata fuerint. Qui aliquam in his rebus ſcientiam poſſident, cauſam hujus Diſſipationis in rationibus ſupra memoratis facilè inventuri ſunt, præſertim cùm reputaverint partem hujus Mercurii inter diſtillandum ſuperficiei perampli magni Excipuli adhærere; alteramque partem, nubecularum formâ, Aquæ, quam ſemper neceſſe eſt in Excipulum infundere, ſuperficiei ſupernatare.

Hac operatione didici, Mercurium ex plumbo, per digeſtionem Mercurii cum plumbo tres Annos continuatam, & per diſtillationem violentiſſimam, nullum poſſe extrahi, neque Argentum vivum per hunc modum fixari in plumbum: in diſtillatione enim Mercurii, parva ejus quantitas ſemper mutata eſt in rubrum pulverem, qui fixus eſt ad ignem hìc applicatum; pondus verò plumbi ſemper idem remanſit.

V.

Eandem inſtituebam Operationem cum Amalgamate è 3 unciis Argenti vivi & unica uncia boni ſtanni facto; eidem caloris gradui exponebam per idem tempus. Deinde eodem modo ex Retorta vitrea diſtillabam ad eundem ignem: En qualis fuit Eventus! Ex Excipulo uncias 2 cum Drachmis 4 Mercurii recepi; in fundo Retortæ fuit pulvis, cujus pars altera fuit tenuis, & è pauxillo Mercurii fixati compoſita; altera fuit craſſior, nigra, compoſita è minimis particulis, quales ſunt Stanneæ. Imo collo Retortæ adhæſit adhuc paululum Mercurii: quod totum pependit Drachmas 2 cum granis 5. In fundo fuit maſſa ſolida ſtannea pendens unciam unam cum drachma unica & granis 9: fuit 46 granorum jactura; cujus rationes jam reddidi.

Pater

Patet hac operatione Mercurium haud extrahi poſſe ex Stanno; ſed Drachmæ 3 cum 14 granis, hoc eſt, plus ſeptimâ Mercurii parte, cum Stanno uniebantur, & tam bene fixabantur, ut ab illo ſeparari non potuerint continuato 4 horas igne, qui arenam candefaceret. " Non autem te lateat magnam eſſe correſponden-" tiam inter Saturnum & Lunam, quorum in medio " Sol conſtitutus eſt; ſicuti inter *Jovem* & *Mercu-" rium*, in quorum medio Sol etiam conſiſtit:" lege in Nov. Lumin. Chem. tractat. IX.

VI.

Mercurii uncias 10, poſtquam probè calefecerim, affundebam 2 unciis optimi in cochleari ferreo mundo liquefacti Stanni. Triturabam totum in Amalgama uniforme, quod valdè calidum & probè ſiccum indebam lagenæ vitreæ mundæ & calidæ, quam poſtea bene obturabam; capſulâ ligneâ includebam, quam caudici tundenti [pilæ] molendinæ fulloniæ continuò agitatæ affigebam, cui annexa motum à 30 mo. Novembris 1732. uſque ad 9m. Januarii 1735. noctu diuque paſſa eſt ferè perpetuum. Auferebam tunc lagenam, quæ integra fuit, in cujus fundo repertus eſt Mercurius fluens; & poſt quietem aliquorum dierum, in ſuperna parte inventum eſt amalgama duriuſculum; totum pependit omninò uncias 12. Diſtillabam in Retorta vitrea lutata uncias 11. & 7 drachmas hujus amalgamatis, & hoc igne nudo finem verſus uſque aucto, dum retortam penitus candefaceret per 2 horas. Non exivit major, quàm quæ immiſſa fuit, copia Mercurii, qui fluidiſſimus erat, & remanſit in fundo maſſa ſtannea vitro affixa cum pauxillo materiei luteæ, quæ erat quaſi foliata. Maſſa hæc fuſibilis inſtar ſtanni erat ad ignem mediocrem; & tunc ſuperficies aëri expoſita pingebatur diverſis coloribus. Maſſa ſtannea pependit unciam unam cum 6 $\frac{1}{2}$ drachmis, & affuit adhuc parva materiei.

riei luteæ jam memoratæ quantitas. Certum eſt itaque, quòd, ope motûs per tam longum tempus continuati Mercurius non poſſit Stannum diſſolvere eo modo, quo poſſit extrahi Mercurius per diſtillationem ſummo igne factam.

SCHOLIUM.

Res egregia, quam in hiſce tribus Operationibus ultimis obſervavi, eſt, quòd Mercurius diſtillando ſeparatus à plumbo vel à ſtanno eſſet quàm liquidiſſimus, & quòd agitatus in poculo fictili vitreato albido mundo, ſuperficiem poculi brevi temporis ſpatio inquinaret, ibique relinqueret maculam nigram admodum adhærentem. Simul ac maculam hanc chartâ purâ & probè ſiccâ detergendo purgaveram, formata eſt alia, & illico pluribus iteratis vicibus aliæ. Hoc me induxit, ut cogitarem, id eſſe attribuendum parti metalli pingui, quæ inter diſtillandum tranſivit cum Mercurio, et ab ejus ſuperficie, cui adhæſit, tunc ſeparata fuit. Ut de hoc facto certiorem me redderem, Mercurium hunc ſupra chartam albam puriſſimam ſicciſſimamque expandi, cui reliquit ille tramitem levem nigrum, quacunque pertranſivit; ſuperficies alioquin hujus Mercurii ſemper fuit tecta pellicula tenuiſſima, quæ pinguedini ſimilis videbatur. Ergo, quamvis per Mercurii diſtillationes ſæpè iteratas potuerint cum Mercurio uniri aliorum Metallorum particulæ quædam, non inde ſequetur, quòd ullæ particulæ in Mercurium verſæ fuerint. Idem Experimentum aggreſſus ſum, cum plumbo quod per idem tempus eodem motu agitatum fuit: quando autem volui à pilâ molendinæ amovere, per infortunium fracta eſt lagena; & perdita materia, non potui ad finem perducere operationem.

Experimenta hæc naturæ Argenti vivi afferre poſſunt plus luminis. Plura alia inſtitui de Mercurio & Me-

Metallis, omninò ab hiſce diverſa, quæ mihi labore multò majore conſtiterunt; ea, cùm otium fuerit, communicaturus ſum.

X. ECLIPSIS LUNÆ *partialis die ſecundo* Octobris, *Styl. nov.* Anno MDCCXXXV. Vitimbergæ Saxonum *obſervata à* Jo. Frider. Weidlero, *R. S. S.*

Hor.	Min.	Sec.	*Temp-europ. ante Mer. D.* II. *Octob.*
0	44	30	Penumbra prope Schikardum.
	59	0	Initium eclipſis.
1	1	30	Umbra appellit ad Schikardum. Margo illius aſper eſt et inæqualis. Paulo poſt lunam nubes occultant.
1	15	0	Tycho totus obumbratur. Mox iterum lunam nubes ſubeunt.
1	25	30	Portio lunæ obſcurata nigreſcit, nec maculæ per umbram teleſcopio IX pedum diſcerni poſſunt.
1	30	0	Umbra appellit ad Grimaldum. Jam trans umbram maculæ conſpiciuntur.
1	44	30	Umbra totum tegit Grimaldum. Jam rubet portio obumbrata. Mox luna iterum nubibus conditur.
2	25	30	Umbra recedens attingit Lansbergium. Adhuc ejus margo aſperitatem habet.
2	44	0	Umbra appellit ad Gaſſendum.
3	11	0	Emergere incipit Tycho.
3	36	0	Finis ſupra Snellium, ſereno circa lunam cœlo.

Addend. to the Note at p. 319.

I thought it proper to add the following Paſſage taken out of the Journal-Book of the *Royal Society*, ſuppoſing it to be what Mr. *Oldenburgh* hints at in his Letter.

“ *Nov.* 16, 1671. [Sir *Robert Moray*] exhibited a certain Plant,
“ (which was by Mr. *Wray* called *Lichen terreſtris cinereus*) ſaid by
“ Sir *Robert Moray* to be very good to cure *Dogs bitten by mad Dogs:*
“ His Royal Highneſs having cauſed it to be given to a whole Kennel
“ of Dogs, bitten by a mad one, which were all cured, except one of
“ them, to whom none of it was given.”

The Specimen was kept in the Repoſitory.

The ſame Virtue is likewiſe aſcribed to this Plant, in the *Third Part* of *Moriſon's Plantar. Hiſtor. Oxon.* publiſhed at *Oxford Anno* 1699. in Folio, p. 632. where the Author, ſpeaking of the *Lichen terreſtris cinereus, Raii Hiſt. & Synopſ.* ſays, *Adverſus morſum canis rabidi egregium eſt Medicamentum.*

Dampier, and the *College of Phyſicians*, in their *Pulv. Antilyſſus*, preſcribe equal Quantities of the *Lichen* and *Pepper:* But Dr. *Mead*, in a ſingle *Quarto Leaf* publiſhed by him *Anno* 1735. hath alter'd the Proportions of the Compoſition, preſcribing double the Quantity of *Lichen* to that of the *Pepper*. This difference in the Proportions muſt be left to the Judgment of Practitioners; but upon the Authority of another Minute in the Society's Journal-Books, it may not be improper to make an Addition to the above-mention'd *Dampier's Powder*.

“ *March* 7, 1671-2. Sir *Robert Moray* mention'd, that a whole Ken-
“ nel of Dogs, belonging to his Royal Highneſs, were bitten by a
“ mad Dog, and had been lately cured by a certain Herb called *Stel-*
“ *laria*, or *Star of the Earth.*”

This Plant is the *Lychnis viſcoſa, flore muſcoſo Caſp. Bauhin.* in Engliſh, *Spaniſh Catch-fly*. See theſe *Tranſactions*, N° 187. where is a *Receipt to cure mad Dogs*, &c. wherein this Plant is a principal Ingredient; which Receipt, communicated by Sir *Robert Gourdon*, was there publiſhed by *his* MAJESTY's [*ſpecial*] *Command*, *Anno* 1687.

Wherefore, ſuppoſe the Compoſition were to be thus:

> *Take* Aſh-colour'd Ground-Liver-wort, black Pepper, *and the Herb* Spaniſh Catch-fly, *all finely powder'd, of each two Drachms, for four Doſes, to be taken as* Dampier *preſcribes in his Letter in theſe* Tranſactions, N° 237.

ERRATUM.

P. 336. *& alibi, for* Ilion, *r.* Ilium.

Numb. 444.

PHILOSOPHICAL TRANSACTIONS

For the Months of *November* and *December*, 1736.

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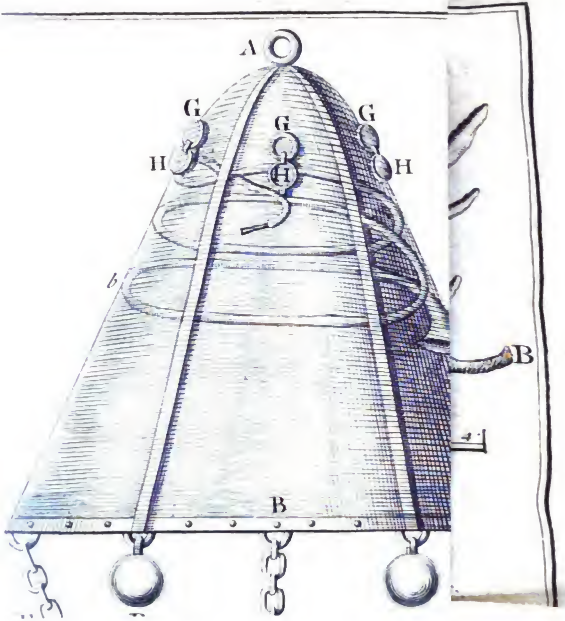
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1. *A Letter from his Grace the Duke of* Richmond *to Sir* HANS SLOANE, *Bart. Preſident of the* Royal Society.

London, Thurſday Oct. 31, 1734.

SIR,

BEing juſt arrived from *Suſſex*, where I heard a very extraordinary Account of an Earthquake that happened there on *Friday* the 25th Inſtant, between Three and Four in the Morning, I take this firſt Opportunity of laying before you and the *Royal Society*, what Accounts I was able to collect during my Stay there. I know moſt of the People that have ſigned the incloſed Papers, to be Perſons of Veracity: And what confirms me in my Opinion that there really was an Earthquake, is, that almoſt every body agree in the ſame Deſcription, as to the Senſation, the Hour of its happening, and the perfect Calm that was at that Time. I obſerve the Shock was vaſtly more felt towards the Sea-ſide, as at *Shoreham*; *Tarring*, *Goreing*, *Arundel*, and *Havant*. At my Houſe of *Goodwood*, which is near three Miles North of *Chicheſter*, and about Seven from the Sea, it was not ſo perceivable as at *Chicheſter*, and where it was ſtill leſs ſo than by the Sea-ſide. I do not hear as yet that there was the leaſt Touch of it in any Parts of the Vale on the North Side of the Downs, which for the moſt part run Eaſt and Weſt. I think, what Dr. *Bayley* of *Havant* ſays of the different Motions of the Beds, according to the different Situations they were in, is very well worth obſerving. This Gentleman is a Doctor of Phyſick, and a very curious Man. I could have got above fifty more Accounts from the ſeveral Places I have mentioned; but as they all tend to the ſame Purport, I thought what I had already collected ſufficient. I am, Sir,

Your obedient,
Humble Servant,

RICHMOND and LENOX.

2. *A* Narrative *of the ſame* Earthquake *by* Edward Bayley, *M. D.*

Havant, *Octob.* 25, 1734.

BEtween three and four o'Clock in the Morning, an Earthquake was felt here: The Shock was ſo conſiderable as to be obſerved by one or other in moſt Houſes of the Town. I happened to be awake at that Time, and perceived the Bed ſhake under me with a quick tremulous Motion, which continued about two or three Seconds, then ceaſed; and after a very ſhort Intermiſſion was repeated in the ſame Manner, and laſted about the ſame Space of Time, as near as I could gueſs. I was at firſt much ſurprized at ſuch an unuſual Phænomenon; but upon a little Recollection, concluded it muſt be occaſioned by an Earthquake, and was ſoon confirmed in my Conjecture by the concurrent Obſervations of my Neighbours, and afterwards by Accounts of the ſame from many other Places; in ſome of which it ſeems to have been more violent than here. Several Perſons in this Place ſay they not only perceived the ſhaking of their Beds, but alſo the rocking of their Houſes, together with a rumbling Noiſe of Drawers and the like moveable Goods in their Chambers and other Rooms. A learned and ingenious Gentleman in this Town informs me, that the Motion of his Bed appeared to him like the toſſing of a Veſſel when it croſſes over a Wave, the Head and Feet thereof riſing and falling alternately ſeveral times; whereas mine ſeemed rather to rock from Side to Side: But theſe contrary Motions of the two Beds are eaſily accounted for, by conſidering the different Poſitions of them, my Friend's ſtanding directly Eaſt and Weſt, and mine North and South: For ſuppoſing the undulatory Motion which the Earth might have at that Time was propagated from Eaſt to Weſt, the ſame kind of Motion which cauſed his Bed to riſe up and down longways, muſt make mine rock from Side to Side; as may be obſerved in two Veſſels ſailing in contrary Directions on the ſame Waves of the Sea, that which croſſes the Waves at Right Angles being toſſed up and down endways, while the other moving in a

Line parallel with the Waves, will be rocked from Side to Side. What makes me the more inclined to think the progreſſive Motion of this Earthquake to have been from Eaſt to Weſt, is, becauſe it appears from the beſt Accounts I have yet had of it, that it was obſerved ſooner Eaſt than Weſtward, and likewiſe extended further from Eaſt to Weſt than North and South.

It may not be amiſs to take Notice of ſome remarkable Phænomena which happened before and after, as well as ſome other Circumſtances which immediately attended this Earthquake, moſt of them agreeing with thoſe Signs which have been obſerved by the learned to precede or accompany former Earthquakes in theſe and other parts of the World. It is obſervable, that we have had of late more Rain and Wind for ſeveral Months ſucceſſively, than for many Years paſt; eſpecially from the Beginning to the Middle of this Month, about which Time it cleared up, and the Weather became ſuddenly very cold with froſty Mornings, the Wind blowing generally pretty hard from N. W. On *Wedneſday* the 23d, the Cold abated conſiderably; it was cloudy, but we had no Rain that Day. The 24th was very calm all Day; it rained moſt part of the Afternoon, though the Mercury ſtood at $30\frac{3}{10}$. It continued very calm all Night, and rained hard for ſome time before and after the Earthquake happened; but it ſoon cleared up, and we had a ſtrong Gale of Wind, which roſe within half an Hour, or, as ſome ſay, within a Quarter, afterwards: It continued blowing hard all the Forenoon. At four o'Clock in the Morning I obſerved the Mercury continued at 30

Inches $\frac{2}{10}$, the Spirit of Wine at 55 $\frac{5}{10}$; having riſen about five Degrees ſince the late cold Weather.

N. B. My Barometer and Thermometer are both in one Frame, made by Mr. *Hawksbee.*

Octob. 29, 1734. Edward Bayley.

The Circumſtances related by his Grace, and by Dr. *Bayley*, are backed by the united Teſtimonies of ſeveral; many of whom are known to his Grace to be Perſons of Veracity, and whom he procured to ſign Certificates of what they obſerved concerning this Accident at *Chicheſter* and other Places. It is unneceſſary to trouble the Reader with each Certificate; the mentioning the Names of thoſe who have ſubſcribed them may ſuffice.

John Fletcher, *Andrew* and *Sarah Adaire*, *Jane Johnſon*, *Martha Freeland*, *Owen Apps*, *Sarah Bryers.*

Sarah Tutte, and her Children *Eleanor*, *Jane* and *Sarah.*

John Coſtellow, *John Freeland*, *Matthew Fathers.*

John and *Sarah Bryers*, *John Long.*

Thomas Turgis, *Richard Silverlock*: All of the City of *Chicheſter.*

Philip Boiſdaune, Eſq; of the Pariſh of *Funtington* in the County of *Suſſex.*

This laſt-mentioned Gentleman, and the aforeſaid Perſons, dwelling in the City of *Chicheſter*, all agree that there was a manifeſt Shock of an Earthquake felt on *October* 25, about a Quarter before Four in the Morning, which laſted by fits ſome few Seconds, about a quarter of a Minute, or while one might tell Twenty, with a Motion ſenſibly ſlow: For moſt of the Accounts concur in this Particular, that the Chairs, Wainſcot, Doors, Cheſts of Drawers, and other Moveables, were heard rattling; and one, that a Bell rung of itſelf juſt before they felt the heaving of their Beds; and that there was no Wind ſtirring at that Time, but that it rained, and the Wind roſe ſoon after.

The Revd Mr. *Richard Green*, Prebendary of *Chicheſter*, and Rector of *Merſton*, in the County of *Suſſex*, had Informations of the ſame Tremblings, attended with the ſame Circumſtances, being felt at *Shoreham*, *Goreing*, *Tarring*, *Findon*, *Arundel Caſtle*, and *Merſton*.

John Shaw, *Thomas Dagly*, and *John Towner*, all Servants to the Duke of *Richmond*, at his Seat called *Goodwood*, felt the ſame.

Mr. *John Jenkins*, Riding Officer of the Cuſtoms, in the Pariſh of *Weſt-Wittering*, near *Bragleſham-Bay*, in the County of *Suſſex*, deſcribed the Shock after the ſame Manner: And he adds further, that within half a quarter of a Mile of his Houſe, a young Man, of about 18 or 20 Years old, having been at the ſame Time to fetch up a Team of Horſes from Graſs, the Horſes were ſo ſenſible of ſomething more than ordinary, that they trampled, and ſeemed very much affrighted, as they were coming home.

3. *Of a Shock of an* Earthquake *felt in* Northamptonſhire, *in* October 1731.

TO the foregoing Accounts of an Earthquake felt in *Suſſex*, it is thought not improper to ſubjoin, from the Regiſters of the *Royal Society*, the following Intimation from the Revd Mr. *Joſ. Waſſe*, Rector of *Aynho* in *Northamptonſhire*, of " a Shock " of an Earthquake felt there on *Sunday*, *Oct.* 10. " about four o'Clock in the Morning, *Anno* 1731. " This Gentleman ſaith, that his Windows rattled, as " if ſomebody had been dancing over-head. The " Concuſſion laſted about a Minute; others thought " it laſted about two Minutes. It alarmed the neighbouring Villages, *Bloxham*, four Miles South-Weſt " from *Anyho*; *Barford*, five; *Banbury*, four Weſt; " *Adderbury*, a Mile Weſt; *Crowton*, a Mile to the " Eaſt; and *Charlton*, as much to the North. There " was no Notice of its Progreſs South or South-Eaſt. " About a Minute after, ſome of the Town of *Aynho* ſaw a great Flaſh of Lightening. In the Morning the Sky looked of a Land-colour. It was ſaid " that there was a former Shock felt upon *Oct.* 8. " about Three in the Morning; and that the latter " was preceded by a Noiſe like diſtant Thunder."

It is remarkable, that this Shock was perceived to extend more from Eaſt to Weſt, than from North to South; which Particular was likewiſe obſerved in the laſt Shock felt in *Suſſex* 1734.

IV. HER-

II. HERMANNI BOERHAAVE, *A. L. M.* *Philoſoph. & Med. Doct.* Medicinæ *in Univerſitate* Leidenſi *Profeſſ. Colleg. Chirurgic. Præſ.* Reg. Soc. Lond. *necnon* Reg. Scient. Acad. Pariſienſ. Soc. *de* MERCURIO Experimenta.

Pars III. *

BIennium, & ultra, eſt, a quo obſervationes de argento vivo obtuli conſeſſui Philoſophorum in Britannia; atque, anno dein ſequenti, ſuper eadem re alia quædam conſcripſi ad Academiam Scientiis promovendis dicatam a Sereniſſimo Galliarum Rege. Ex utriſque conſtitit mutata nunquam hydrargyri natura, licet variata mire ſpecie, in novas crebro formas mutatus appareret. Alias juvat jam operationes recitare, unde major longe ejuſdem conſtantia probatur, ſimulque & aliorum metallorum indoles exponetur. Alchemiſtarum antiquiſſimi, quos & optimos jure quis dixerit, uno ubique ore palam aiunt, mercurium eſſe metallum vivum. Sed & clamant iidem, hunc, quando habetur ſincerus, omniſque alieni contagii purus, adeo tunc ſimplicem deprehendi, ut ſit quacunque parte ſui prorſus idem, impatiens penitus dividi in partes varii ingenii. Dicunt porro, ea quoque gratia immutabilem omni cauſæ, et adeo quidem penetrabilem ſimul, ut alia quæque diſſolvere queat, ipſe interim nihil quidquam, vel inde quoque, mutatus. Atque uti in hiſce quidem inter ipſos quam apertiſſime convenit, ita quoque conſentiunt omnes, nunquam de venis duci ſuis immaculatum, ſemper vero inquinatum hauriri labe aliena, quæ prima ab origine illi concreta, hinc mite inoleſcens, intime etiam immiſta ſit. Dolent ſane, vitium illud quam moleſtiſſimo inde labore auferri tantum poſſe: quia in primæva ſeminis fœtura principiis naſcendi ipſis ſe inſinuavit, & indiſſociabili fere vinculo innexuit. Vocabant illud Sulphur, quod puro Mercurii ſe immiſcet. Hujus reſpectu ſolum, invenerunt, Argentum vivum mutabile eſſe; hoc unicum, accuſant, impedire acrem ejus penetrabilitatem, obtundendo, atque hebetando, propriam Mercurio aciem; hinc & ſimplicem puri caſtitatem degenerare in copulam, & connubium, cum peregrinis, ſolo lenocinio advenæ pararii. Si vero arcana quadam via purificaret fortunatus ſimul, & ſapiens, artifex hunc Mercurium ab omni hac congenita in natalibus ſpurcitie, tum eſſe illum ultra haud mutabilem; accepiſſe autem vim ſubtilitatis, qua per omnia alia ſe penetret; ſpernere connubia cum aliis, dedignari thalamos, nec dari in natura rerum corpus, cui ſe dedat, cœlibatus caſtiſſimi pertinaciſſime tenax. Sed quam admirabile ingenium tremuli laticis! quo redimendum labore, quo pretio! Cruda coquit, perficit vilia, metalla, alia quælibet corpora prompte attenuat, reſolvit, in humidum convertit radicale; ſic, ad arcana medicinæ, ad ſecreta hermeticæ artis, princeps inſtrumentum jure laudatur, quo quid, ſummo. Sane Myſtæ artis, atque Epoptæ, narrant nobis, eſſe igni ſimilem, qui omnia non mutandus unquam mutat, qui dividens quælibet, qui omnia aſſocians, ipſe intactus, nuſquam vinctus, recedit.

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* *Vide* Part I. *Tranſact.* N° 430. p. 145. *& ſeq.* Part II. N° 443. p. 343.

Illecebræ tantorum promiſſorum excitavere Hermeticos, ut omni ope niterentur modum diſcere, quo infectum Hydrargyro vitium poſſent eluere, ut pura nitentem ſimplicitate ſibi præſto haberent. Et quidem igne ſolo maculam exurendam cenſebant horum ſapientiſſimi: quia ignis purgator metallorum unicus. Nata hinc Mercurii in vitris emaculatis, undique clauſis, in ampullas vitreas puras, per ignem elevatio. Hanc vero geminabant toties, donec in rubrum, micantem, pulverem, totum convertiſſent. Sed pollinem hunc igne ſummo dum urgent in vitris mundiſſimis, en reſuſcitant inde priſtinum Hydrargyrum. Exſultantes pro defœcato exceperunt, falſo tamen: quippe hic ipſe, reſurgens ſuis de cineribus combuſti, phœnix, nova tali ignis actione patitur, ſe denuo ſimilem in pulverem rutilum, fulgentemque, cogi. *Atqui* palam negant ſummi magiſtri, Argentum vivum, arte vera purgatum, rite adeo defœcatum, unquam cogi poſſe ab igne in pulverem, ne quidem continuata in ſempiternum actione. Super qua quidem re legi merentur forte ea, quæ ſuper his commentabar, dum enarrabam DXI. ejuſdem Mercurii in vaſis vitreis deſtillationes vi ignis factas, in Actis Collegii Philoſophorum in Britanniis, anni MDCCXXXIII. menſe Novembri & Decembri.

An igitur tali modo dabitur adeo quæſita depuratio? Vix credibile. Sed alia forte fuit operandi ratio, qua præcipitur illa peragenda. Quin et artis principes aperte dictant diverſam: aiunt enim, defœcationem obtineri ſperatam, dum Mercurii indagatus nucleus detinetur a corporibus puriſſimis, ex amicitia conſanguinitatis arcte eum, & ſtabili conjugio, jungentibus ſibimet. Atqui Aurum, Argentumque, pura, fixa, ipſique Mercurio ſincero metalla quam ſimillima; ſive originem ſpectaveris, ſive materiem. Sequi ex his ſtatuunt, ſi permiſcetur perfecto Mercurius metallo, atque iterum igne inde expellitur intra bene clauſa vaſa vitrea, partem metalli puri in ſe tracturam Mercurium, ſimulque ſordidum Mercurii ſecreturam puro. Animo meo volupe fuit, experiundo diſcere, quid hac in ſententia veri foret. Si non faſtiditis, paucis horæ momentis diſcere eventa laboris improbi, dabo, quæ mihi placere confiteor: quoniam vana me dedocuerunt multa, quæ alte menti inſita alebam; & didici quoque pauca bona, erranti ſalutaria. Frui poſſunt ſtudioſi rerum naturalium ærumnoſi operis fructibus; neque neceſſe erit earum tempus, atque ſumtus ſatis profuſos, ſimilibus impendere. Id ſi obtinget, mihi habebo ſummum pretium, quod ambio.

Auri puriſſimi, quod arte docimaſtica parari poteſt, duas cum dimidiata uncias redemi ex officina publica argentariæ Amſtelædamenſis; redegi in maſſulas, quæ ſingulæ pendebant ſemiunciam. Quinque has indidi in vitrum mundum, quod chemici retortum appellant; affudi ſuper his integris Argenti vivi, puri, ſemel prius deſtillare coacti, uncias XXV. Igne coegi exſcendere Mercurium ad dimidias ab Auro, quod in fundo ſubſidebat ſub Mercurio. Peracta ſic operatione, exierant Mercurii unciæ XIII. in excipulum; in fundo vaſis erat Aurum penitus jam diſſolutum in Mercurio, ſpecie miſti perfecti, candidi, quod amalgama dicunt: unde patet, Aurum ſolo æſtu ebullientis Mercurii diſſolvi; iſque videtur optimus modus miſcendi hæc bina, quod artis vocabulo dicunt amalgamare. Argentum vivum

quod

quod exſcenderat, bene ſiccatum reddidi reſiduo in retorta; iterum expreſſi igne æqualem inde Mercurii copiam, quam denuo ſiccatam affudi ad reſiduum. Hocque ea lege repetivi quinquageſies. Ultima vice exiverat purus Mercurius. Amalgama in fundo retortæ ſuperſtes, nigreſcens, trivi in mortario vitreo, vitreo piſtillo; turbabatur lutulenta aqua, quam effudi. Lavi cum pura affuſa, quam terendo rurſus lutulentam effudi. Id tredecim diebus fieri curavi, quando non ſordeſcebat amplius tritu aqua, ſed ſplendide fulgens reſtabat amalgama, pura manebat aqua. Pulvis tritu, & lotu, paratus, colore fuſcus, ſapore tetrico metallico horridus, bene ſiccatus, pependit grana LXXXIII. Mercurius & Aurum pendebant ℥XXVI. ʒVII. Perdita grana VII. drachmæ tres cum ſemiſſe, quinquaginta operationibus. Id contingit partim difflatu volatilis, partim adhæſu Mercurii ad chartam *bibulam, qua ſiccatur* ab aqua, in quam deſtillando fuerat exceptus.

Puriſſimum hoc amalgama iterum, eodem modo tractavi quinquaginta aliis vicibus. Exiverat jam vice quinquageſima purus Mercurius: in fundo vaſis manſerat amalgama fuſcum. Id denuo tritum, lotumque, cum aqua, ut ſupra retuli, poſt tredecim dies operi impenſos, dedit pulveris abluti, fuſci, ſiccati ʒI gr. XLIV. Amalgama tum puriſſimum cum Mercurio educto, pendebant ℥XXVI. ʒIV. perdidi his L operationibus ʒI. gr. XVI.

Rurſus depuratum hoc amalgama, plane eadem ratione quinquageſies feci deſtillare. Exierat purus Mercurius: in fundo retortæ amalgama ſubruſum. Id aqua tritum, lotumque, ut prius, quatuordecim dies, dedit pulveris fuſci ʒI. gr. II. Amalgamati puro addidi Mercurium egreſſum, pendebant ſimul ℥XXIV. ʒV. gr.

xxiv. Sed in fundo retortæ, dum amalgama effundebam, aliquid amalgamatis remanſerat vitro adhæreſcens: ut perditum ſupputare nequiverim.

Depuratum amalgama quinquageſies iterum ſic tractatum, deſtillando, terendo, lavando, per quatuordecim dies, dedit pulverem fuſcum pondere ʒiß gran. iv. amalgama ſplendentiſſimum ſimul cum egreſſo puro Mercurio miſtum, pendebat ℥xxv. ʒii. gr. xlvi. poſt ducentas deſtillationes.

Et hoc amalgama quinquageſies urſi, ut prius; dein denuo trivi cum aqua, ſedecim dierum ſpatio; nactus ſum pulveris fuſci ʒii. ℈i. gr. iv. amalgama ſplendide candidum cum Mercurio pendebat jam ſimul ℥xxv. ʒi. gr. xlvi.

Hoc labore perfunctus vidi ducentis & quinquaginta deſtillationibus Mercurii ab Auro, ſic inſtitutis, Aurum & Mercurium dediſſe pulveris deſcripti unciam, & grana quinque. Reſtitiſſe Auri & Mercurii ℥xxv. ʒi. gr. xlvi. Periiſſe de materie, ratione enarrata, ℥i. ʒii. gr. ix.

Quæ, dum intentus contemplabar, efficiebant, ut lætabundus ſuſpicari inciperem, me videre deſideratam adeo methodum luſtrandi Hydrargyri. Cogitabam, in eo abſcondi forte culpatam Mercurii labem. Quandoque putabam, totum hunc pollinem merum eſſe fœtidum ſpurcumque Sulphur, quod immaculatam Argenti vivi virginitatem contaminaverat. Dubitabam, ſi non ipſe jam purum a balneo ignis & aquæ, ſpectarem, nudumque Deorum nuncium! Temperabat impetum recordatio ſimilis ſæpe, ſed præcocis, gaudii, in fumos inanes toties dilapſi. Ambiguus decrevi, non requieſcere, donec certa fides doceret verum. Igitur ℥xxv. ʒi. gran. xlvi. puriſſimi illius ultimi amalgamatis iterum deſtillare coegi præterea, aliis ſexcentis viginti & ſeptem vicibus, dimidium Mercurii ſemper educendo, affundendo ſemper: nec volui plus lavare aqua, ſed cernere, quid fieret. Solebat hoc opere nigreſcere materies, ut tandem colore fere atro fœdaretur. Obduxi tum vitrum, in quo erat, lorica ignem ferente apertum; ſicque atrum amalgama, non ablutum ultra, egi igne ſummo ita, ut retorta ſpatio trihorii prorſus ab igne canderet. Exiit Mercurius puriſſimus ad ℥xx. In fundo vaſis deinde fracti reperi uncias IIſs Auri fulgentiſſimi, ſine ulla omnino fœce relicta. En exitum rei! nec dolui ægrimonia triſtium laborum: ſane eventum, haud præviſum, jam certo cognitum, hac mercede dignum habui. Neque olei, nec operæ, pœnitebit unquam.

Sumebam deinde pollinem, quem collegeram CCL. deſtillationibus, ejuſque ʒVII. grana *LVII. urſi igne* ſummo, aperto, ex retorta loricata, ut diu hæc canderet. Exiit de hoc pulvere Mercurius puriſſimus, reſuſcitatus, ad ʒVII. gr. XLVI. In fundo retortæ reſtiterant, ut deprehendi, grana ſex pulveris fuſci.

Argentum vivum, quod jam DCCCLXXVII. repetitis vicibus ita urſeram, ponderavi arte, induſtria, & ſtatera hydroſtatica, amici cariſſimi, celeberrimi profeſſoris, 'sGraveſande. Habuit ſe ad aquam puram, ut XIIIſs ad I: ut molimine tanto denſitatem haud mutaverit Mercurius, neque ulla parte ſui leviore fuerit liberatus. Id jam addo: quia intellexi quid de ſuſpicione nata, haud ſatis accuratam fuiſſe rationem, quam adhibui ad exploranda pondera, quæ memoravi in primis, quæ Societati dedi, de Mercurio commentariis. Fas mihi eſto, pauca jam ex deſcriptis colligere, pro veris habenda.

1. Aurum a Mercurio ſolutum, cum eo toties coctum, tritum, nihil de natura ſua priſtina mutavit, amiſit de pondere proprio nihil, quod his experimentis notari queat, nihil acquiſivit.

2. Argentum vivum Auro commiſtum, ab eo per ignem rurſus expulſum, partem ſui convertit in pulverem fuſcum, ſubtilem, ſaporis tetrici, metallici, penitus diverſi ingenii a priore ſua natura, idque fit ſemper, uſque ad DCCCLXXVII. vices. Qui tamen, ſolo igne fortiore, iterum redit in Argentum vivum idem, quod antea fuerat, omni dote per artem obſervabili.

3. Igitur ignis & aurum, hoc modo, non ſeparant ab Argento vivo partes diverſas, ſulphur, fœces, aliud. Sed tantum id mutant ſpecie externa, iterum reducenda in formam priſtinam, omni ratione eandem ita, ut ne quidem pondus ejus proprium ullo modo mutatum ſit.

4. Argentum vivum & Aurum vi ignis mutant ſtatim argenteum ſplendorem ſui amalgamatis in colorem fuſcum, tandemque nigrum: ſed ſolo igne fortiore nitor Mercurio argenteus, & fulvus Auro fulgor, redditus docet, hunc colorem non demonſtrare metallorum corruptionem, vel mutationem in ſua natura.

5. Si tamen auro & igne purgari poteſt Mercurius nativus, ex ſententia veterum, oportet alia id operatione efficere.

6. Cadit ſpes mercurium fixandi cum Auro actione ignis: quum tanto molimine, tempore tanto, nihil quidquam vel inchoatum ſit; ultima deſtillatio æque facile, ac prima, peragebatur.

7. Non firmatur hinc opinio, quæ narrat, ignem metallis, vel Mercurio, concreſcere poſſe in augmentum,

tum, vel generationem, alicujus metallici; aut in mutationem ipſius metalli ſtabilem.

8. Quæ conſtantia, quæ ſimplicitas, Argenti vivi, & Auri! Si in origine prima aurum fuit Argentum vivum: nonne tunc vere dicitur, Mercurium, vel totum avolare ab igne, vel fixum in eo manere totum?

9. Magna promiſſa, de Auro tritu ſolvendo, ſive cum aqua, ſive ſine illa, quæ duo magni in arte viri fecere, non ſolvuntur hiſce noſtris laboribus. Sed vana ſpes: fugerunt laborem improbum, præcipites feſtinarunt ad otioſas concluſiones.

Unicum ſupererat inquiſitu dignum; An Mercurius, jam toties deſtillans ab Auro per vim ignis, haud depoſuiſſet eam proprietatem, qua per deſtillationem vertitur in pulverem illum, qui appellatur præcipitatus per ſe? Igitur uncias illas viginti Argenti vivi DCCCLXXVII. vicibus deſtillati ab Auro deſtillare coegi ex retorta munda vitrea, tam magna vi ignis, ut nihil prorſus Mercurii remaneret in vitro poſt ſingulas deſtillationes; id repetivi octies: in fundo retortæ obtinui grana duodecim rutili, ſcintillantis, ponderoſi, ſapore tetrico metallico præditi, præcipitati Mercurialis. Certus ergo, ne hanc quoque dotem ablatam mercurio per magnum hunc laborem.

III. *A*

III. *A Letter to the Reverend* John Theoph. Deſaguiliers, *L. L. D. F. R. S. from Mr.* Martin Triewald, *F. R. S. Captain of* Mechanics, *and* Military Architect *to his* Swediſh MAJESTY, *concerning an Improvement of the* Diving Bell.

Stockholm, Nov. 1. 1732.

Reverend SIR,

HAVING the ſole Privilege for diving on all the Coaſts in the *Baltic* belonging to his *Swediſh* Majeſty, no Opportunity has been wanting to make ſufficient Trials with the Diving Bell and Air Barrels in ſeveral Depths, according to the ingenious Improvement of that worthy Gentleman Dr. *Edmund Halley*, made in the Year 1716, but with ſome ſmall Additions.

Experience has likewiſe convinc'd me, that no Invention built upon any other Principles than thoſe of the *Campana Urinatoria*, can be of Uſe in any conſiderable Depths; or that the Diver, in any other Invention whatever, can be a ſingle Moment ſafe. I will not, for Brevity-ſake, mention the many Impediments that attend other Inventions, only that of a Water Armour, in which the Man is drowned in an Inſtant, when ſuch a Machine receives the leaſt Leak: Whereas Experience has ſhewn, that when ſuch an Accident has happen'd to the Diving Bell, as to my Knowledge it did once, when the Diver was 12 Fathom under Water, and a pretty large Hole happen'd to be ſtruck in the Bell, by a Boult of the Wreck he went upon, at which Time the Air ruſh'd out of the ſame with ſuch Violence as aſtoniſh'd the Beholders by the exceſſive boiling on the Surface of the Water, fearing, not without Reaſon, that the Man in the Bell was drowned; but he clapped his Hand to the Hole or Leak, and gave a Sign to be haul'd up, which was done with all the Eaſe and Safety as if no Accident had happen'd to him, the Water having only riſen about half a Foot into the Bell by this Leak.

The very ſame Diver that was then in the Bell is 63 Years of Age, and has uſed the Buſineſs of Diving ever ſince he was 20, in a common Diving Bell, till of late, and is as yet a pretty ſtrong and healthy Man: He declares that never a worſe Accident happen'd to him in his Buſineſs but once, when the Bell *he was in ruſh'd* down at once about a Fathom or more, by the Careleſſneſs of thoſe that work'd the Bell; at which Time the Blood came out of his Noſe and Ears, feeling beſides an intolerable Preſſure on his whole Body; which ſhews, that when a Man in a Diving Bell is ſlowly and gradually let down, he at ſuch a Time and by Degrees reſpiring compreſs'd Air, which by the Lungs is forc'd into the Blood, cannot feel the external Preſſure, tho' of highly compreſs'd Air, ſurrounding him, and that of the Water reaching ſome Parts of his Body, which Convenience no other Invention can yield or afford, where the Diver is to draw his Breath from Air in its natural State.

I have often with a great deal of Pleaſure obſerved, that when I have caus'd the Bell to ſtop, being lower'd down five Fathom, and the Diver taking in the Air contain'd in an Air Barrel, lower'd down a Fathom deeper than the Bell, without opening the Cock for diſcharging the hot Air; the Water would, by the Acceſs of the Air out of the Barrel, be quite, or to a very ſmall Matter, expell'd out of the Bell; and when the ſame was again lower'd down five Fathom more, the ſame Operation with another Air Barrel repeated, and the Bell afterwards haul'd up, it was no ſmall matter of Delight to ſee, that every Fathom the Bell came up, it would diſcharge itſelf of the ſuperfluous and large Quantity of Air, which came up from the Bottom of the Bell in very large Bubbles, as big as Eggs of an *Oſtrich*; which Diſcharge of Air and Phænomenon continued, till the Equilibrium of the Air in the Bell, and Preſſure of the Water, was reſtor'd, and till the Bell came above the Surface of the Water.

At other Times I have obſerved, when no Air was by the way taken into the Bell, but the ſame lower'd down the common Way, and haul'd up again after ſome Time, that the very Inſtant when the Bell ſhould part with the Surface of the Water, the Strength of two Men more was required at the Capſton at that Time, than before and after the Bell hung freely in the Air; from whence I preſume it plainly appears, that the Air which paſſes thro' the Lungs of a living Creature, loſes its Elaſticity, and that the Lungs of a Man make a kind of a Vacunm in the Bell; for which Reaſon the Diver feels at the very Inſtant, when the Bell parts with the Water, a very ſmart Preſſure in his Ears.

Tho' Experience thus has taught me, that no Invention is more ſafe and uſeful than the *Campana*

Urinatoria, with the ingenious Improvements of Dr. *Halley*; yet I have likewiſe found, that this Invention is not to be made uſe of without conſiderable Charge, requiring a large Veſſel, and Number of Hands, to the working and managing of ſuch a large Diving Bell, and the Air Barrels with their reſpective Weights for ſinking; which Charges, however, according to the Depth of Water, and the Value of what is to be fetch'd up from the Bottom of the Sea, may not be regarded: But ſince it more frequently happens in theſe Parts, that Cargoes of a far leſs Value than the Loadings of *Spaniſh* Galleons, *&c.* are to be dived for; then next to the Goodneſs of the Invention, I have found myſelf neceſſitated to think how the Expences might be leſſen'd, and that the Diving Bell nevertheleſs might anſwer all Intents and Purpoſes of Dr. *Halley's*; which Improvement I take herewith the Liberty to communicate to you, which is as follows:

The Diving Bell, A B. (*ſee Fig.* I.) I have caus'd to be made of Copper, and reduc'd the ſame to a very little Compaſs in regard to that of Dr. *Halley's*, as you'll ſee by the Scale under the Draught, by which means it is eaſily managed by two Hands: Yet I preſume that a Diver may not only live in the ſame for as long a Time, and with as much Eaſe, at a very conſiderable Depth of Water, as in a Bell of twice its Capacity, for this Reaſon, tho' a Man in a large Bell has undoubtedly more Air than in a leſs, and conſequently ſhould be able to ſubſiſt a great while longer on a large Quantity of Air than on a ſmall Parcel; yet becauſe his Head for the moſt part is kept in the upper Part of the Bell, where the hot Air takes up its Place and Reſidence, he receives very little or no Benefit of the Air under his Chin or Breaſt, tho' never ſo fit for Reſpiration; which Air nevertheleſs in the lower parts of the Bell will remain cool a long time after he has been in the Bell, and with Difficulty drawn his Breath; which cannot be denied, and is very obvious to any body who has been in a *German* Bagnio, and ſuch as are made uſe of in this Country, where in a ſingle Room all the Degrees of Heat are to be felt, by means of a Contrivance like Stairs to the very Top of the Ceiling, a Man when he places himſelf on the uppermoſt Step will feel an exceſſive Heat, ſo that any body not very much uſed to it cannot endure the ſame, nor draw his Breath, but will faint away; whereas on the firſt, ſecond and third Steps from the Floor, the Heat is very moderate; nay, ſometimes the Air near the Floor pretty cool, when at the ſame time near the Ceiling the Heat of the ſame is intolerable. I will not mention many other Inſtances I could produce.

To encounter this Inconvenience I have cauſed a ſpiral Tube of Copper, b, c. to be placed cloſe to the Inſide of the Bell, ſo fixed that the ſame may be taken out and cleanſed at Pleaſure, and with Eaſe; and at the ſame time not to incumber the Diver when he is in the Bell; at the upper end of this Tube b, a flexible Leather Tube is join'd two Foot long, at the End of which is a turn'd Ivory Mouthpiece, which the Diver (as ſoon as he perceives the Air to grow hot in the Top of the Bell) keeps conſtantly in his Mouth, which he is able to do by means of the flexible Tube in whatever Poſture he is in, ſtanding, ſitting, bowing his Head, *&c.* And all the while he draws his Breath thro' the aforementioned Tube, and the Air from c; by which Contrivance he not only draws continually cool and freſh Air as long as any is in the Bell, but occaſions at the ſame time a Circulation, which is ſo neceſſary to the very Being of Air, (eſpecially in a compreſs'd State) and its Preſervation for the uſe of Animals, which I have found to be of great Conſequence; and ſo much the more neceſſary, as any body who has been in a Diving Bell for a long Time, without any new Supplies of Air, and has been reduc'd to the laſt Extremity of breathing in the ſame, will agree with me, that when at ſuch a Time the Bell begins to be haul'd up, and by that means the compreſs'd Air allow'd to expand and be put into Motion never ſo little, the Man receives, as it were, a new Life, and incredible Comfort and Eaſe.

Again, when, in Coal-pits, Levels are drove in the Coal or thro' Dykes, the Air of the Level or Adits growing hot by the Breath and Sweat of the Hewers and Workmen for want of a Circulation of the Air; I have found it to be an excellent Remedy, to place along the ſide of the Drift or Adit, a ſquare wooden Box, open at both Ends, laid from the Place where the Air is cool and good, reaching as far, by joining one Box cloſe to another, as where the Work is carried on. Thus, by this ſimple Contrivance, a Circulation of Air is obtain'd, and ſometimes to that Degree, that when a Candle is held at the End of the Box where the cool Air enters, the Flame is driven out by the Current of cold Air entring and circulating thro' the Box.

By which Experiment I am apt to think, that tho' the Diver ſhould not keep the End of the flexible Tube in his Mouth, which he may do with all the Eaſe in the World, yet that the Air would circulate thro' the Copper Tube, and he receive no ſmall Benefit by it. D D D D are the Weights for ſinking the Bell, ſo contriv'd as with great Eaſe to be hook'd on the ſame hanging on the Cable. The Iron Plate E, fixed to the Chains F F F, ſerves the Diver to ſtand upon, when he is at work.

The Bell is extremely well tinn'd within all over; and as in all Rivers, and the Coaſts of the *Baltic Sea*, the Water is extremely clear and bright, becauſe of no Ebb and Flood, I have plac'd three ſtrong convex Lenſes G G G. By theſe means the Diver can not only ſee what is under him, but likewiſe on all ſides at a good Diſtance.

Theſe Glaſſes have ſtrong Copper Lids like Snuff-boxes, H H H; which Lids are ſhut, when there is no Occaſion to diſcover any Objects on the Bottom of the Sea, and ſerve to preſerve the Glaſſes from being broken.

I hope you'll pardon the Liberty I have taken to trouble you with a long Letter, which I might have inlarg'd with an Account of other Inventions, which, if you approve of this, ſhall in a little time follow; in the interim I beg you'll grant me leave to remain with much Reſpect, *Moſt Reverend SIR,*

Your moſt obedient and devoted,
humble Servant,

M. Triewald,
F. R. S. Berl. and *Swed.*

IV. *A*

IV. *A Letter from* Samuel Dale, *M. L. to Sir* Hans Sloane, *Bart. Preſident of the* Royal Society, *containing the Deſcriptions of the* Mooſe-Deer *of* New-England, *and a ſort of* Stag *in* Virginia; *with ſome* Remarks *relating to Mr.* Ray's *Deſcription of the* flying Squirrel *of* America.

Worthy SIR,

THE Preſent which I herewith make you, is the Head, or rather the *Attire* (as it is called in *Heraldry*) of the *Mooſe-Deer*, ſent me ſome Years ſince from *New-England* by the Honourable *Samuel Shute*, Eſq; then Governor of *that Colony*. This Animal hath been mention'd by ſeveral Authors, but their Accounts have generally been ſo very imperfect, that little Satisfaction hath thereby been given to the curious Inquirers after Natural Hiſtory. The firſt Mention that I find of this *Mooſe Deer* is by Mr. *Joſſelyn*, in a little Tract called *New-England Rarities*, where, Page the 19th, that Author writes, *That it's a goodly Creature, ſome of which being* 12 *Foot high, their Horns exceeding fair, with broad Palms, ſome being two Fathoms from the Tip of one Horn to the other.* Much to the ſame purpoſe is the Account he gives of this Animal in another Book of his called *Two Voyages to New-England*, p. 88. in which he ſaith, that *The* Mooſe, *or* Elke, *is a Creature or rather a Monſter of Superfluity, when full grown, being many times bigger than an* Engliſh Ox. What *Neal* in his *Hiſtory of New-England*, Vol. II. p. 573. hath of this Animal, called by him the *Moſe*, is copied from the aforeſaid *Joſſelyn*. The beſt and fulleſt Account of this Animal was ſent by the Honourable *Paul Dudley*, Eſq; Fellow of the *Royal Society*: This is publiſhed in the *Philoſophical Tranſactions* of the *Royal Society*, N° 368. p. 165. where he makes them to be of two Sorts, *viz. The common light-grey Mooſe*, called by the *Indians*, *Wampooſe*; and *the large or black Mooſe*, which is the Beaſt whoſe Horns I herewith preſent *. As to the *grey Mooſe*, I take it to be no other than what Mr. *John Clayton*, in his Account of the *Virginian Quadrupedes*, publiſhed in the aforeſaid *Tranſactions*, N° 210. p. 122. calls the *Elke*; which Beaſt by the *Pariſians*, in their *Memoirs for a Natural Hiſtory of Animals*, Engliſhed by Mr. *Pitfield*, Page 167. is called by the Name of the *Stag of Canada*, of which I have ſeen a ſingle Horn, ſent by Mr. *Mark Catesby* from *Virginia*, by the Name of an *Elks-horn*, and was in all reſpects like thoſe of our *red Deer* or *Stags*, only larger, weighing about 12 Pounds *Haverdupoiz*, and from the Burr to the Tip, meaſured by a String, about ſix Foot high. Mr. *Dudley* writes, that his *grey*

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* The Dimenſions of theſe Horns, ſee Fig. 2. are as follow.

		Inches.			Inches.
A	B	56	a	b	11
C	A	34	a	cb	20
C	E	31	a	d	12 ½
C	D	34	d	f	12 ½
D	H	30	d	e	11
F	G	9 ½	g	h	2 ¾
F	I	14			
K	L	7			

Mooſe is moſt like to the ordinary *Deer*; that they ſpring like them, and herd together ſometimes to 30 in a Company: But whether he means by that Term the *Red*, the *Virginian*, or the *Fallow-Deer*, is uncertain, he having ſaid nothing of their *Horns*, which was needful to diſtinguiſh them. The *black Mooſe* is (by all that have hitherto writ of it) accounted a very large Creature. Mr. *Joſſelyn* (as I before mentioned) makes it many times bigger than an *Ox*; and Mr. *Dudley* writes, that the Hunters have found a *Buck* or *Stag-Mooſe* 14 Spans in Height from the Withers, which at nine Inches to the Span, is ten Feet and a half; and that a *Doe* or *Hind* of the fourth Year, killed by a Gentleman near *Boſton*, wanted but one Inch of ſeven Feet in Height. *The Stag, Buck,* or *Male* of this kind hath a *palmed Horn,* not like that of our common or *Fallow-Deer,* but the Palm is much longer, and more like to that of the *German Elke,* from which it differs, in that the *Mooſe* hath a branched Brow-Antler between the Burr and the Palm, which the *German Elke* hath not.

Nor doth the *Horn* of this *New-England black Mooſe* agree in Figure with either of thoſe mentioned in the *Philoſophical Tranſactions*, N° 227. p. 489. and N° 394. p. 123. to be found *Foſſil* in *Ireland*, the laſt of which, Mr. *Kelly*, writes, that for want of another Name they called them *Elks-Horns*. I ſuſpect that thoſe *Horns* which the late Reverend and Learned Mr. *Ray* mentions in his *Synopſis Methodica Animalium Quadrupedium* to have ſeen with one Mr. *Holney*, an Apothecary of *Lewis* in *Suſſex*, as likewiſe in divers *Muſeums*, were not the Horns of this *black* or *American Mooſe*, but of the *German Elke*, becauſe that inquiſitive Gentleman takes no Notice of any *Brow-Antlers* that they had; which, I think, was too notorious to have eſcaped his Obſervation, had had there been any ſuch.

Concerning the Number of young-ones, or *Calves*, which the *Mooſe* brings forth at a time, Authors vary; for Mr. *Dudley* ſaith, that they bring forth but two; but *Joſſelyn* in his *Two Voyages*, p. 89. and from him *Neal*, that they are three, and that they do not go ſo long pregnant as our *Hinds* by two Months. What theſe two laſt-mentioned Authors write concerning their caſting their *Calves* a Mile diſtant from each other, doth not ſeem to me probable. Nor do I find that *Neal*, in his Deſcription of this Beaſt, makes any mention of their having a long Tail, tho' ſo charged to do by Mr. *Dudley*, who likewiſe omits the *Brow-Antlers* in his Deſcription of their *Horns*.

There is another Beaſt of the *Deer-kind*, which, tho' very common in *Virginia*, and without Doubt in other of the Northern Provinces of *America*, yet I think it is not deſcribed by any Author; (but it is expected that it will not eſcape being taken Notice of by Mr. *Catesby* in his *Natural Hiſtory of* Florida, *&c.*) Mr. *Beverly*, in his *Preſent State of* Virginia, mentions both *Elke* and *Deer* in that Country, but doth not deſcribe either: But by what I have received from Mr. *Catesby*, the firſt ſhould be the *Canada-Stag*, and the other the *Deer* I have here mentioned. Mr. *Clayton* likewiſe mentions the *Elke*, which he ſaith are beyond the inhabited Parts, and are the ſame with Mr. *Beverly*'s; as alſo the *Deer*, of which he ſaith there are Abundance, yet doth not deſcribe them, but calls them *Red-Deer*, tho' they are not the ſame as we here call by that Name, but of thoſe which follow. Mr. *Neal* likewiſe mentions *Deer* in *New-England*, but gives only the Name, which being general, nothing can be inferred from it.

That which I take for the undeſcribed *Deer*, is a Beaſt of the *Stag-kind*, having round Horns like them, not ſpreading out as in the *Stag* or *Red-Deer*, but meeting nearer together at their Tips, and bending forward over the Face of the *Animal*; the *Brow-Antlers* likewiſe are not crooked and ſtanding forward, but ſtrait and upright (*ſee Fig.* 3.). The Skin of this *Deer* is of an *arenaceous* or ſandy Colour, with ſome black Hairs intermix'd, and ſpotted all over, while young, with white Spots, like ſome ſorts of our *Fallow-Deer*, being alſo about the Bigneſs of them when fully grown. The *Dama Virginiana Raii Synop. Animal. Quad.* p. 86. which *was formerly in* St. *James's-Park*, ſeems to be different from this, if Mr. *Willoughby* was not led into a Miſtake in taking it to be of the *Palmate-kind*, by only ſeeing it when the *Horns* were ſhed. Perhaps this laſt of Mr. *Ray* may be the *Mauroufe* of *Joſſelyn*'s *Voyages*, p. 91. which, he ſaith, is like the *Mooſe*, but his Horns are but ſmall, and the Beaſt about the Size of a *Stag*; but his Deſcription is too ſhort to be ſatisfactory.

There are other ſorts of *Deer* mention'd by Mr. *Joſſelyn* in his laſt-quoted Book, p. 87. as Inhabitants of that Country, as the *Buck, Stag*, and *Rain-Deer*; but whether they are the ſame with thoſe called by the ſame Names in *Europe*, I cannot determine, the Deſcriptions of them being omitted. He mentions likewiſe, for another ſort of *American-Deer*,

Deer, an Animal called a *Maccarib*, *Caribo* or *Pohano*; but by the Account he gives, it ſeems to be a Fiction, no ſuch *Animal* being, I believe, in *Rerum natura*.

I find that Mr. *Ray* in his *Synop. Quad.* p. 215. rather refers the *Sciurus Americanus volans*, to the *Mouſe* than to the *Squirrel-kind*; becauſe their Tails are broad and plain, and not turn'd over their Backs when they ſit; which Miſtake may perhaps ariſe from only ſeeing the Skin of one dead, when the Hair of the Tail had been eaten off by *Mites*; for in one that I did ſee alive, which was brought over from *Virginia* by Madam *Cock*, Siſter to Mr. *Catesby*, the Tail was hairy, as in others of the *Squirrel-kind*, tho' rather more thin, and did turn over the Back as other *Squirrels* do.

N. B. The ſame Species of flying *Squirrels* hath been found in *Poland*; a Deſcription of which, with an accurate Figure, is given by the Learned Mr. *Klein*, F. R. S. in N° 427. of theſe *Tranſactions*.

As to the large *Horns* found *Foſſil* in *Ireland*, I have taken particular Notice, (in ſeveral I have ſeen) beſide the main Horns being palmated, that the Brow-Antlers are likewiſe palmated; which is a Circumſtance peculiar to the *Rein-Deer Species*, being of great Service to them in removing the Snow, in order to get at the Graſs or Moſs underneath, which is their chief Subſiſtance in *Lapland*. *C. M.*

V. *An Attempt to explain the* Phænomenon *of the* horizontal Moon *appearing bigger, than when elevated many Degrees above the* Horizon: *Supported by an* Experiment. *By the Rev.* J. T. Deſaguiliers, *LL. D. F.R.S. Communicated* Jan. 30, 1734-5.

THIS apparent Increaſe of the Moon's Diameter (which a Teleſcope with a Micrometer ſhews to be only apparent) is owing to the following early Prejudice, which we have imbib'd from Children.

When we look at the Sky towards the Zenith, we imagine it to be much nearer to us, than when we look at it towards the Horizon; *ſo that it does not* appear Spherical, according to the vertical Section E F G H I, (Fig. 4.) but Elliptical, according to the Section e F g h i. For this I appeal to every body's Senſe of ſeeing; but not to their Reaſon, which is apt to take off the Prejudice in Perſons that have ſome Knowledge of Aſtronomy. Whereas any other Perſon looking up very high towards the Sky, and then forwards near the Horizon, will (when asked) ſay that the Sky over his Head appears much nearer. The Sky thus ſeen, ſtrikes the Eye in the ſame Manner as the long arch'd Roof of the Ile of a Cathedral Church, or the Cieling of a long Room.

This being premiſed, let us conſider the Eye at C, upon the Surface of the Earth, and imagine C at the Surface to coincide with K at the Centre; to avoid taking into Conſideration that the Moon is really farther

ther from the Eye when in the Horizon, than when it is ſome Degrees high. Now when the Moon is at G, we conſider it as at g, not much farther than G; but when it is at H, we imagine it to be at h, almoſt as far again. Therefore, while it ſubtends the ſame Angle as it did before (nearly), we imagine it to be ſo much bigger as the Diſtance ſeems to us to be encreaſed.

I have contriv'd the following Experiment to illuſtrate this: Fig. 5.

I took two Candles of equal Height and Bigneſs A B, C D, and having plac'd A B at the Diſtance of ſix or eight Feet from the Eye, I placed C D at double that Diſtance; then cauſing any unprejudic'd Perſon to look at the Candles, I ask'd which was biggeſt? and the Spectator ſaid they were both of a Bigneſs; and that they appear'd ſo, becauſe he allow'd for the greater Diſtance of C D; and this alſo appear'd to him, when he look'd thro' a ſmall Hole. Then deſiring him to ſhut his Eyes for a Time, I took away the Candle C D, and plac'd the Candle E F cloſe by the Candle A B, and tho' it was as ſhort again as the others, and as little again in Diameter, the Spectator, when he open'd his Eyes, thought he ſaw the ſame Candles as before. Whence it is to be concluded, that when an Object is thought to be twice as far from the Eye as it was before, we think it to be twice as big, tho' it ſubtends but the ſame Angle.——And this is the Caſe of the Moon, which appears to us as big again, when we ſuppoſe it as far again, tho' it ſubtends but the ſame Angle.

The Difference of Diſtance of the Moon in *Perigeo* and *Apogeo*, will account for the different

Bigneſs of the Horizontal Moon at different Times, adding alſo the Conſideration of the Faintneſs which Vapours ſometimes throw on the Appearance.

VI. *An* Explication *of the* Experiment *made in* May 1735, *as a farther Confirmation of what was ſaid in a Paper given in* January 30, 1734-5. *to account for the Appearance of the* horizontal Moon *ſeeming larger than when higher. By the Same.*

HAVING made an Experiment with three Ivory Balls for Confirmation of what I had advanced, namely, that the Deception ariſes from our *judging* the *horizontal Moon* to be much farther than it is; ſome Gentlemen of the Society were convinced by the Experiment, but others were not; which obliges me to give this further Account of it, that People may judge of the Thing in Writing, which could not be ſo well attended to in the Hurry of ſeveral Perſons viewing the Experiment in Haſte.

1. Two equal Ivory Balls were ſet one beyond another in reſpect of the Eye at E, namely, AB at 20 Feet Diſtance from the Eye, and CD at 40.

2. It is certain, by the Rules of Optics, that the Eye at E or F will ſee the Ball CD under an Angle but half as big as it ſees the Ball AB; that is, that the Ball CD muſt appear no bigger than the Ball op placed by the Side of AB.

3. But when looking at the two Balls (Fig. 6.) with the naked Eye in an open Room, we conſider that CD is as far again from the Eye as AB, we judge it to be as big as AB, (as it really is) notwithſtanding it ſubtends an Angle but of half the Bigneſs.

4. Now if, unknown to the Spectator, (or while he turns his Back) the Ball CD be taken away, and another Ball *op* of half the Diameter be placed in the ſame Line, but as near again, at the Side of AB, the Spectator thinking this laſt Ball to be at the Place of CD, muſt judge it to be as big as CD, becauſe it ſubtends the very ſame Angle as CD did before.

It follows therefore——That if a Ball be imagin'd to be as far again as it really is, we make ſuch an Allowance for that imagin'd Diſtance, that we judge it to be as big again as it is, notwithſtanding that the Angle under which we ſee it, is no greater, than when we look at it, knowing its real Diſtance.

For this Reaſon the Moon looks bigger in the Horizon, and near it, than at a conſiderable Height, or at the Zenith: Becauſe it being a common Prejudice to imagine that Part of the Sky much nearer to us which is at the Zenith, than that Part towards the Horizon; when we ſee the Moon at the Horizon, we ſuppoſe it much farther; therefore as it ſubtends the ſame Angle (or nearly the ſame Angle) as when at the Zenith, we imagine it ſo much bigger as we ſuppoſe its Diſtance greater.

The Reaſon why this Experiment is hard to make, is becauſe the Light from the Ball *op* is too ſtrongly reflected on account of its Nearneſs; but if we could give it ſo little Light as to look no brighter than the Ball CD, it would deceive every body. I have made the Experiment ſo as to deceive ſuch as were not very long-ſighted; but I muſt confeſs I have found it very hard to deceive thoſe who ſee at a great Diſtance; tho' they would all be deceiv'd, if the Diſtances were of 300 or 600 Foot. Now in the Caſe of the Moon, the Deceit is help'd, becauſe the Vapours, thro' which we ſee it when low, take away of its Brightneſs, and therefore have the ſame Effect as would (or does) happen in the Experiment, when the Light of the Ball *o p* ſtrikes the Eye no ſtronger than the Light of the Ball C D.

VII. *A Letter from* Joſeph Atwell, *D. D. F. R. S. and Principal of* Exeter College, Oxford, *to Dr.* Mortimer, *R. S. Secr. containing ſome Obſervations on a* Man *and* Woman *bit by* Vipers.

Exeter College, Oxford, July 24, 1734.

S I R,

THE Man who was lately bitten by a *Viper* in the Preſence of yourſelf and ſeveral Members of the *Royal Society*, having been recommended to ſome in this Place by Dr. *Oliver* of the *Bath*, I imagin'd that Sir *Hans Sloane* and you will be pleaſed with an Account of ſuch Experiments as have been made here. *July* 3d, the Man was bit in the Preſence of ſeveral, beſides myſelf, in the public Hall of this College. He received two Punctures in the Wriſt, a little above the Thumb: The Blood iſſued, and more Venom lay upon on the Orifices, than could be immediately imbibed. The Man complain'd in about half an Hour's Time, that the Poiſon was got up to his Shoulder, and entering his Body; but notwithſtanding this, we did not ſuffer him to apply his Medicine [*Sallad-oil*] till an Hour and 10 Minutes after he was bitten: by which Time he began to be fluſh'd and in a Sweat, his Hand ſwoln and diſcolour'd. Upon an Application of his Medicine, he found ſome Abatement of his Pain; but the Swelling appear'd more viſible, and ſpread itſelf farther into his Arm. In about a quarter of an Hour the Man ſunk under the Table, and complain'd of violent Pains in his Back and Bowels, nor could he bear to be moved. At laſt, his Pulſe failing, his Jaw being fallen, his Countenance changed, and Eyes fix'd, we ſtretch'd him upon the Table, and applied the Medicine to his Belly and Stomach. Soon after which, recovering a little, he began to vomit, and brought up more than a Quart of Phlegm and Bile. In this Condition he lay for more than an Hour; and then was remov'd into my Lodgings; where he was ſeized again with a Fit of vomiting, and likewiſe purging, and continued ſo till Midnight. I kept him in my own Houſe above an Hour, in Hopes of his growing better; but his Diſorder ſtill continuing, and the Man being too weak and feeble even to ſtand, I ſent him in a Chair home to his own Lodgings; where he was put into Bed, and after Midnight fell aſleep, and awaked the next Morning perfectly well; excepting that his Arm was ſtill ſwoln, and the Fleſh pitted, as if it had been dropſical. His Arm was bound up in Papers, dipt in his own Medicine; and this was all, as far as I could obſerve or learn, that was applied to it. The ſame Day we cauſed two young Chickens to be bit; one died in two Hours, and the other in four Hours Time. A Third was bit three times, and then had the Medicine applied; but it died at the End of ten Hours. The Fleſh of this laſt was grown very black, and there was much extravaſated Lymph between it and the Skin, which ſtunk inſufferably; but I could not perceive, that the Viſcera were at all diſcolour'd.

July 4th, We had another Fowl, half grown, bit in two Places, and the Medicine was applied: Half an Hour after which, the Fowl eat Meat, and ſeem'd much recover'd, but was dead in fourteen Hours Time. *July* 6th, We cauſed two half-grown Cocks to be bit; the firſt was bit but once, yet violently, and turned black immediately; it had the Medicine applied, eat Meat afterwards, and ſeem'd pretty well; yet died in twenty Hours. The other was bit two or three times, but hardly wounded, and not half ſo much diſcolour'd as the former: We bathed the Wound with *Viper-oil*, but the Fowl died in a little more than two Hours. *July* 8th, We cauſed two young Pidgeons to be bit; the one had *Viper-oil* applied immediately, but ſicken'd and died in four Hours: The other had *Olive-oil* applied, and recover'd perfectly; the Fleſh beginning to return to its natural Colour in about an Hour's Time.

July 17th, The Woman was bit in the publick Hall of *Brazen-Noſe-College*, in Preſence of Dr. *Frampton*, Dr. *Frewin*, and ſeveral other Phyſicians, myſelf, and many others. It had been ſuſpected, that they play'd ſome Tricks with their *Vipers*, and made them ſpend their Rage and Venom beforehand: To obviate which, a Phyſician of the Company had provided ſome freſh *Vipers*, which he had caught himſelf a Day or two before, and kept in his own Cuſtody till that Time. The Woman was bit twice by one of theſe, and received three Wounds, one in the Thumb and two in the Fore-finger. Her Hand was ſoon ſwoln and ſpotted, and her Finger turn'd black. After three and twenty Minutes, ſhe applied the Medicine to her Hand, but not farther than the Swelling went; in which, I think, ſhe was to be blamed, and I ſuſpect the following Illneſs was in ſome Meaſure occaſion'd by it. She walk'd home very well in Appearance: But about three Hours after the Bite was received, ſhe grew very ſick, and in great Pain; was ſeiz'd with Vomiting, Purging, and Fainting-fits, which continued upon her all Night, inſomuch that the People of the Houſe deſpair'd of her Life: Nor had ſhe any Sleep till Noon the Day following. I ſaw her about Six that Evening, when ſhe awak'd, and found her very well in Spirits, but complaining of moſt acute Pains in her Finger. Her Arm, Shoulder, Back, and Breaſt, on that Side, were much ſwoln and inflam'd: All thoſe Parts thus affected were bound up in Papers ſoak'd in the Medicine. After this there appear'd upon her Finger two large Bladders, full of a black corrupt Matter; and this not only upon the Wound, but one of them was upon a diſtant Part of the Finger from it. She could not be perſuaded to open them, which I believe would have eaſed her conſiderably. *July* 20th, The Swelling was conſiderably abated, and almoſt reduced intirely into her Hand, which begun to pit: But ſhe complain'd ſtill of her Finger, and could hardly endure to have it dreſs'd with freſh Papers. She continued in Bed till the 22d, for the ſake of keeping her Hand in a more eaſy Poſture; and then came abroad. The ſame Day that the Woman was bit, we cauſed a Fowl to be bit; but the Wound was not deep, and little more than a Scratch. Nothing was applied to it, and it died in twenty Hours. A large Puppy was bit the ſame Day three times in the Head, had the Medicine applied, but died in about an an Hour. It was known that theſe People kept themſelves faſting thoſe Days when the Experiment was to be tried upon them: This occaſion'd a Suſpicion that they might take ſome Antidote to prepare their Bodies: For which Reaſon, I order'd the Man to bring me ſome *Vipers* after Dinner, laſt *Monday*, under Pretence of making ſome farther Experiments upon Dogs. We had provided at the ſame Time ſome freſh *Vipers* without his Knowledge, and then propoſed to him to be bit by one of them, and apply his Medicine immediately. His Hand was beſmear'd with the Medicine in applying it to a young Dog, upon which we had juſt made an Experiment. Two *Vipers* were tried upon the Man, but neither would bite him: One of them attempted it ſeveral times, and ſpilt his Venom, but always caught back his Head again, as if there had been ſomething in the Hand offenſive. Upon this, ſuſpecting that the Smell of the Medicine might occaſion it, we made him waſh his Hand, after which another *Viper* bit him immediately: But whether our Conjecture was right or not, muſt depend upon farther Trial. The Man received the Bite upon the Joint of the Thumb, and the Blood iſſued at the two Orifices. He applied the Medicine inſtantly: The Thumb appear'd black ſoon, the Hand was ſwoln, and the Fleſh pitted inſtantly. He drank a Mug of Ale after it, and then went home to Bed. Yeſterday Morning, his whole Arm was ſwoln, but the Man was ſo well that he went ſix Miles out of Town, and came home again in the Evening. I have ſeen him again this Morning; the Swelling is almoſt gone above the Elbow, but the Fleſh pits below: The Wound has bliſter'd, but the Bladders were filled with a Water, and not any Thing of that black Matter which appear'd upon the Woman's Finger. We cauſed a young Dog (mention'd before) to be bit the ſame Day, and applied the Medicine: Another Dog was bit three times in the Noſe, and nothing applied: Both are much ſwoln, but very likely to live. We likewiſe thruſt the Teeth of a *Viper*'s Head cut off twenty-four Hours before, into the Fleſh of a Fowl, which turn'd black immediately, but the Fowl is perfectly recover'd without any Application.

I leave you, Sir, to make your own Reflections upon theſe Experiments; and ſhall only add, that I would by no means encourage the Man to go on with them; ſince they muſt at leaſt occaſion him much Pain and Miſery, more than the Gains are worth, and perhaps injure his Conſtitution likewiſe. It is rather to be wiſhed, that he could obtain ſome Reward, and make the Medicine public; in which caſe there would probably be unfortunate Perſons enough in the Country, who would have Occaſion to try it, without torturing themſelves deſignedly. I am,

SIR,

Your very humble Servant,

Jo. Atwell.

VIII. *An*

VIII. *An Account of ſome* Electrical Experiments *intended to be communicated to the* Royal Society *by Mr.* Stephen Gray, *F.R.S. taken from his Mouth by* Cromwell Mortimer, *M.D. R.S. Secr. on* Feb. 14, 1735-6. *being the Day before he died.*

EXPERIMENT I.

TAKE a ſmall Iron Globe of an Inch or Inch and half Diameter, which ſet on the Middle of a Cake of Roſin of about ſeven or eight Inches Diameter, having firſt excited the Cake by gently rubbing it, clapping it three or four times with the Hands, or warming it a little before the *Fire; then faſten* a light Body, as a ſmall Piece of Cork, or Pith of Elder, to an exceeding fine Thread, five or ſix Inches long, which hold between your Finger and Thumb, exactly over the Globe, at ſuch an Height, that the Cork, or other light Body, may hang down about the Middle of the Globe: This light Body will of itſelf begin to move round the Iron Globe, and that conſtantly from Weſt to Eaſt, being the ſame Direction which the Planets have in their Orbits round the Sun. If the Cake of Roſin be circular, and the Iron Globe placed exactly in the Centre of it, then the light Body will deſcribe an Orbit round the Iron Globe, which will be a Circle; but if the Iron Globe be placed at any Diſtance from the Centre of the circular Cake, then the light Body will deſcribe an [Elliptical] Orbit, which will have the ſame Excentricity as the Diſtance of the Globe from the Centre of the Cake.

If the Cake of Roſin be of an Elliptic Form, and the Iron Globe be placed in the Centre of it, the light Body will deſcribe an Elliptical Orbit of the ſame Excentricity as the Form of the Cake.

If the Iron Globe be placed in or near one of the *Focus*'s of the Elliptic Cake, the light Body will move much ſwifter in the *Apogeè* Part of the Orbit, than in the *Perigeè* Part, contrary to what is obſerved of the Planets.

EXPERIMENT II.

Take the ſame or ſuch another Iron Globe, and having faſten'd it on an Iron Pedeſtal about one Inch high, ſet it on a Table, then ſet round it a Glaſs Hoop or Portion of an hollow Glaſs Cylinder of ſeven or eight Inches Diameter, and two or three Inches high: This Hoop muſt be firſt excited by warming and gently rubbing it, then hold the light Body ſuſpended as in the firſt Experiment, and it will of itſelf move round the Iron Globe from Weſt to Eaſt in a circular Orbit, if the Hoop be circular and the Globe ſtand over the Centre of it, but in an Elliptic Orbit with the ſame Excentricity, if the Globe does not ſtand in the Centre of the Hoop, as in the firſt Experiment, when the Globe does not ſtand on the Centre of the Cake.

[What will happen if the Hoop be Elliptic, he did not mention; I ſuppoſe, he had not an oval Glaſs Hoop by him.]

EXPERIMENT III.

This ſame Iron Globe being ſet on the bare Table, without either the Cake of Roſin or Glaſs Hoop, the ſmall light Body being ſuſpended as in Experiments I, II. will make Revolutions round it, but ſlower and nearer to it than when it is placed on a Cake of Roſin, or within a Glaſs-hoop.

REMARKS.

He had not yet found that theſe Experiments would ſucceed, if the Thread, by which the light Body was ſuſpended, was ſupported by any other Thing than an Human Hand; but he imagin'd it might happen the ſame, if the Thread ſhould be ſupported or faſten'd to any animal Subſtance whatever; and he intended to have tried the Foot of a Chicken, a Piece of raw Fleſh, or the like.

He imagin'd to explain the foregoing Particular, by the following odd Phænomenon, of which, he aſſur'd me, he was very certain, having often *obſerv'd it*, *viz*. If a Man reſting his Elbows on his Knees, places his Hands at ſome ſmall Diſtance from each other, they will gradually accede to each other, without any Will or Intention of the Man to bring them together; and they will again recede of themſelves. In the like manner, the Hand will be attracted by the Body; or the Face of a Man, if he ſtand near a Wall, will be attracted to the Wall, and be again repelled by it.

He told me, he had thought of theſe Experiments only a very ſhort Time before his falling *ſick*, that he had not yet tried them with variety of Bodies, but that from what he had already ſeen of them, which ſtruck him with new Surprize every Time he repeated them, he hoped, if God would ſpare his Life but a little longer, he ſhould, from what theſe Phænomena point out, bring his Electrical Experiments to the greateſt Perfection; and he did not doubt but in a ſhort Time to be able to aſtoniſh the World with a new Sort of *Planetarium* never before thought of, and that from theſe Experiments might be eſtabliſhed a certain Theory for accounting for the Motions of the Grand *Planetarium* of the Univerſe.

In trying theſe Experiments ſince his Death, I have found that the ſmall light Body will make Revolutions round a Body of various Shapes and Subſtances, as well as round the Iron Globe, if ſet on the Cake of Roſin; thus I tried with a Globe of black Marble, a Silver Sand-diſh, a ſmall Chip-box, and a large Cork. I obſerved that the Cake, if nothing ſtood upon it, would in any Part ſtrongly attract the light Body, as held ſuſpended by the Thread; but when the Globe, or other Body, was ſet upon it, the Edges of the Cake attracted the ſtrongeſt, and ſo gradually the Attraction ſeem'd as it approached the Centre to grow leſs, till at a certain Diſtance it was changed into a Repulſion, which proceeded from the Globe, or other Body placed upon the Cake, which very ſtrongly repels the light Body, unleſs it be held very near it, and then it attracts it ſtrongly. While the light Body is ſuſpended, as in the foregoing Experiments, if you approach the Finger of the other Hand near it, it will fly from the Finger, or be repelled by it with great Vigour.

IX. *Some* Thoughts *co cerning the* Sun *and* Moon, *when near the* Horizon, *appearing larger than when near the* Zenith; *being Part of a Letter from* James Logan, *Eſq;* *to Sir* Hans Sloane, *Bart. Preſident of the* Royal Society, *&c.*

* * * *Philadelphia, Sept.* 20. 1735.

IT may, perhaps, be needleſs now to add any thing in Confirmation of Dr. *Wallis*'s Solution (*ſee theſe Tranſactions*, N° 187.) of the *Sun* and *Moon*'s appearing ſo much larger at riſing or ſetting, than when in a greater Altitude; tho' ſome have very abſurdly ſtill gone on to account for it from Vapours, which I remember was given me in my Youth for the true Cauſe of it, 'Tis true, indeed, that 'tis theſe Vapours, or the Atmoſphere, alone, that make thoſe Bodies, when very near to the *Horizon*, appear in a ſpheroidal Form, by refracting, and thereby raiſing (to Sight), the lower Limb more than the upper, yet theſe can be no Cauſe of the other. The *Sun* and *Moon*, each ſubtending about half a Degree, appear in the Meridian of the Breadth of eight or ten Inches, to ſome Eyes more, and to others leſs; and in the *Horizon* to be two or three Foot, more or leſs, according to the Extent of Ground they are ſeen over: But if one can have an Opportunity, as I have here frequently had, of ſeeing the *Sun* riſe or ſet over a ſmall Eminence at the Diſtance of a Mile or two with tall Trees on it ſtanding

ing pretty cloſe, as is uſual in Woods without Underwood, his Body will then appear to be ten or twelve Foot in Breadth, according to the Diſtance and Circumſtances of the Trees he is ſeen through; and where there has been ſome thin Underwood, or a few Saplings, I have obſerved that the *Sun* ſetting red, has appeared through them like a large extenſive Flame, as if ſome Houſe were on Fire beyond them. Now the Reaſon of this is obvious, *viz*. that being well acquainted with Trees, the Ideas of the Space they take up are in a Manner fix'd, and as one of thoſe Trees ſubtends an Angle at the Eye, perhaps not exceeding two or three Seconds, and would ſcarce be diſtinguiſhable, were it not for the ſtrong Light behind them, the *Sun*'s Diameter of above thirty Minutes takes in ſeveral of them, and therefore will naturally be judged vaſtly larger. Hence 'tis evident, that thoſe Bodies appear greater or leſs, according to the Objects interpoſed or taken in by the Eye on viewing them. And to this only is that Phænomenon to be imputed.

I am ſenſible this Method of arguing is not new, yet the Obſervations here given may probably tend to illuſtrate the Caſe beyond what had been advanced on the Subject. * * *

FINIS.

ERRATA, which eſcaped Notice in the particular Numbers of this Thirty-ninth Volume of *Philoſophical Tranſactions*.

NUMB. 440. p. 194. l. ult. after the Word *Plant* inſert (*as*
p. 195. l. 1. for *that* r. *from which*.
ibid. l. 3. after *Muſlin* inſert a) to cloſe the Parentheſis.
N°. 441. p. 211. l. 6. for P. *R.* r. *Pr.*
p. 234. l. 8. r. *dilatabatur.*
N°. 444. p. 385. l. 25. before *a b.* 11 *Inches*, inſert *Fig.* 3.
p. 390. l. 26. after the Word *Eye*, inſert *Fig.* 4.

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